MAY 42

RADIO AND HOBBIES IN AUSTRALIA

SHORTAGE OF COMPONENTS

PERHAPS for the first time in the comparatively short history of radio, there is a serious shortage of components. Lines that we have been used to seeing and using for years have either become very scarce or else have ceased to be available altogether.

Up to the present, by drawing on existing stocks and by arranging substitutes, it has been possible to make do. However, if the position continues to deteriorate, it is conceivable that many receivers will have to be set aside "for the duration" for the want of some vital component.

The position is serious enough for servicemen and enthusiasts in the city but it must be very difficult for those in the country, who may have to rely on a single supply channel and who cannot be "on the doorstep" when the very limited number of parts come through from the manufacturers.

A review of the present parts position may be generally helpful. Naturally, it is impossible to be definite and we can only indicate the general position as we see it.

As we have mentioned on other occasions, chassis manufacturers are hard put to it and cannot keep up their previous prolific supply. They are doing their utmost to keep up stocks of half a dozen or so representative chassis, treating all others as specials.

These are made only about once a month, so that, if you want a special chassis and you are unlucky in your timing, you may have to wait quite a while for it. We have been trying to help matters by cutting down on a number of new chassis, even when it may mean hacking another chassis into shape with the aid of hacksaw and file. Any chassis is better than no chassis!

Power transformers and power chokes are rationed because of shortage of raw materials. It is simply a matter of placing an order and waiting for the necessary to turn up.

Gang condensers and dials are not prolific but they appear to be coming through in sufficient quantities. The same is true of broadcast coils and coil brackets for dual-wave receivers without an r-f stage. Coils for receivers with an r-f stage are very scarce indeed.

Hookup wire, tinned copper wire, nuts and bolts are available in limited quantities, distributors apparently adopting the policy of making what they have go round. Small wiring parts are also in supply, but there are few, if any, heavy duty resistors or voltage dividers.

Can-type electrolytics are almost museum pieces and we have to fall back on the semi-dry types, which have the disconcerting habit of shorting when subjected to small overloads.

The sale of valves is being strictly controlled by the authorities. They are alive to the position of the private listener and there is nothing we can do about it but take what is passed on to us after the needs of the forces have been met.

Easily the biggest headache for the country listener is in the matter of dry batteries. When the time comes—and it may not be far distant—when large numbers of battery receivers are out of commission for want of batteries, it will be time for country listeners to make representations to the authorities through their local government bodies.

Country listeners must not be isolated in these critical times, if it can possibly be avoided.

W. N. Williams

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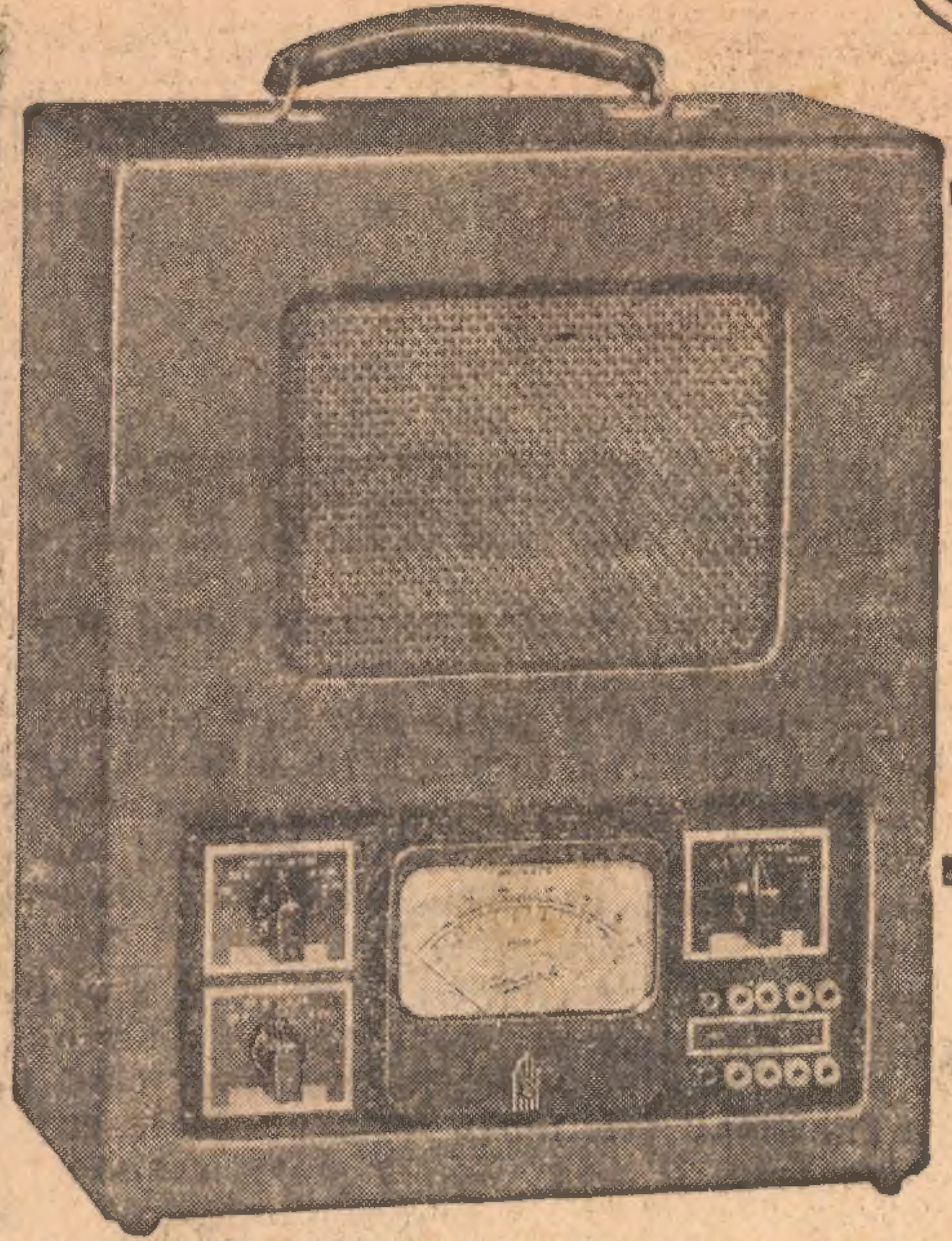
University



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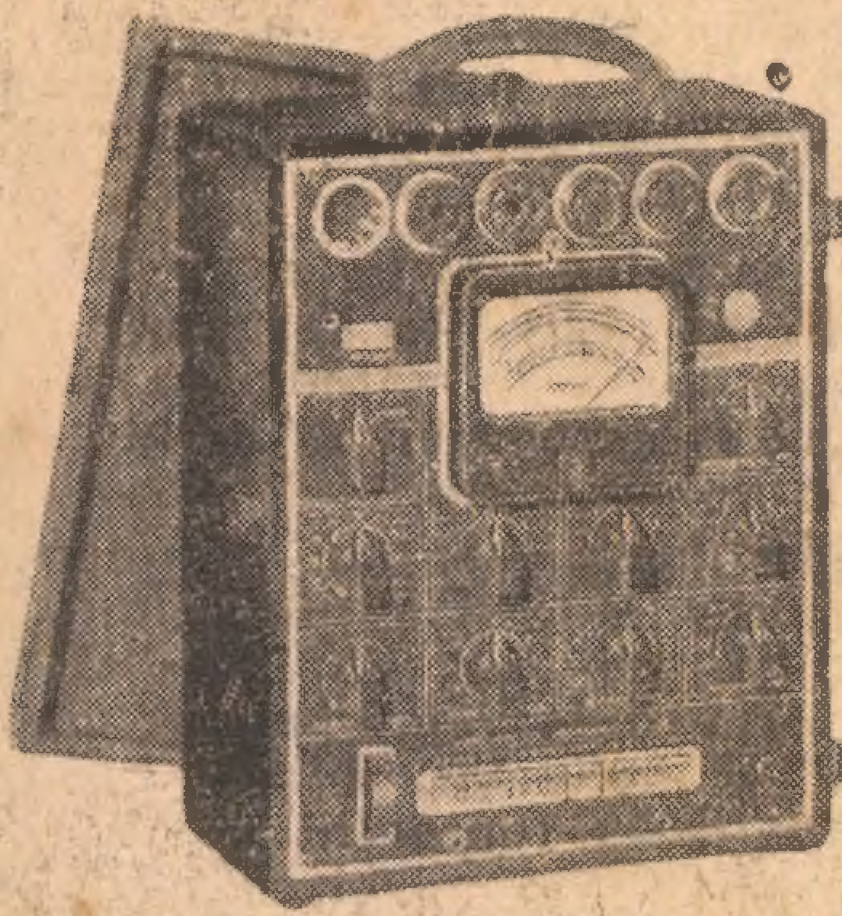

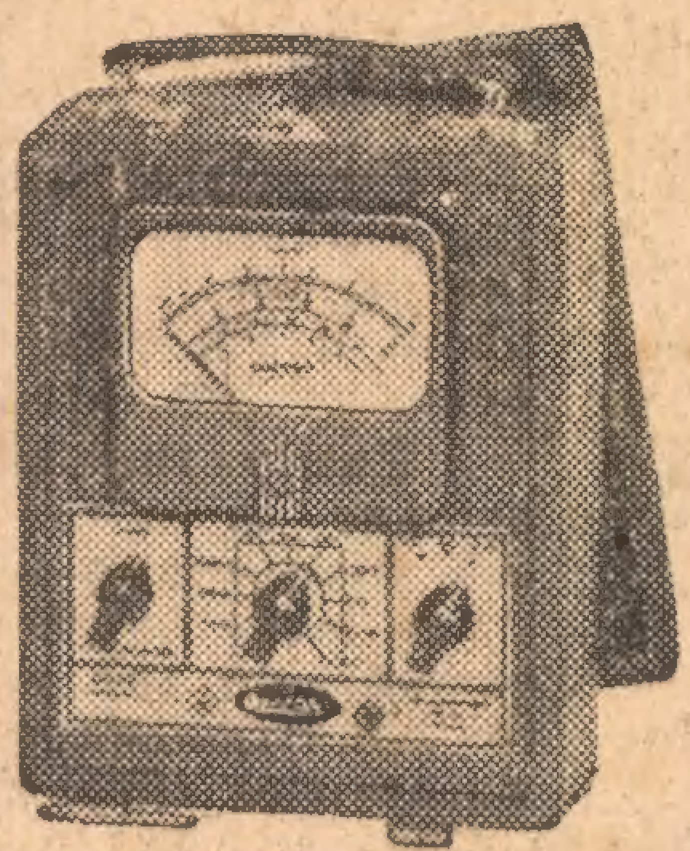

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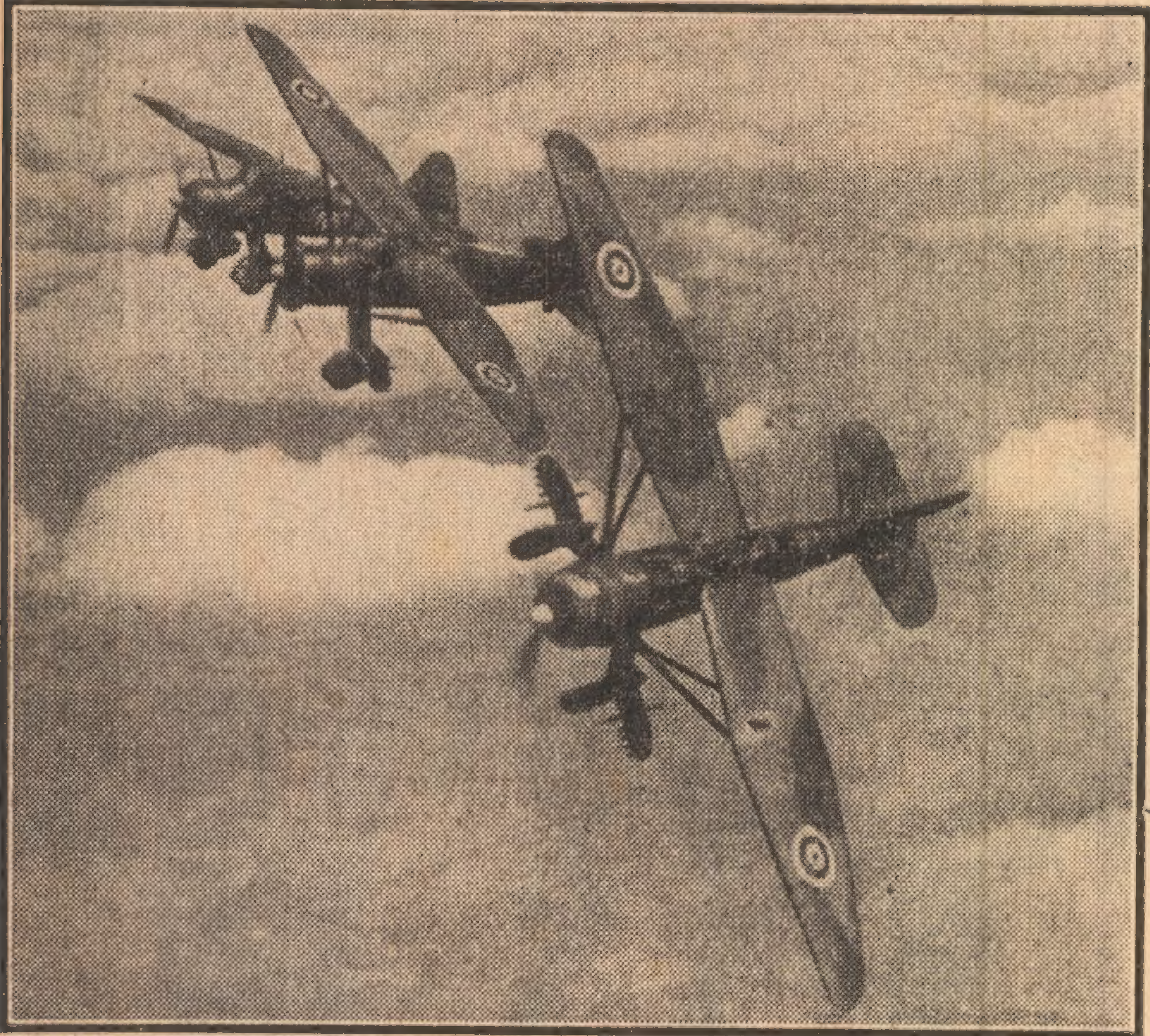
IN VIVID CONTRAST — PEACE AND WAR

Units of the First Armoured Car Regiment crossing a creek on manoeuvres. All Australians look forward to the time when the dark hand of the aggressor shall have been beaten back and peace shall once again reign supreme.

AIRCRAFT ARE THE EYES OF THE ARMY



One of the best known army co-operation planes is Britain's Westland Lysander general purpose monoplane. Equipped with a 905 hp Bristol Perseus motor, the Lysander can fly at any speed between 55 and 230 mph. It will carry food, water or ammunition containers and small bombs may be attached to the bomb racks beneath the stub wings on the undercarriage.

The history of warfare has proven that almost every new weapon has been invented and developed by civilians or by individual officers; but its use in war has been advocated by only a few far-seeing military men, and it has finally been accepted only with the greatest reluctance and misgivings by high-ranking naval and military authorities.

by

L. B. Montague

BACK in 1880, the more conservative officers of the US and British Navies waged a bitter fight to prevent the adoption of the prototype of the modern gun-turret, and even the abolition of sails in favor of steam. Later on, electric propulsion was resisted in the same way. So was the telescopic sight, the torpedo, the submarine, the motor-torpedo boat and, in fact, nine in ten of the methods and appliances that have tremendously increased the effectiveness of navies.

High Army authorities have been no more receptive to new ideas than the Navy. Perhaps less receptive!

A basic lesson of the war that ended in 1918 was that a bullet could penetrate a cloth uniform. Another was that a war of trenches along a continuous front could end only with the economic collapse of one of the contending nations.

The German Army learned both lessons. The British Army evidently did not until the Germans put a striking force behind mobile armor, used divebombers as artillery in tank support, and, in two months, with no more than 200,000 men in this modern equipment, smashed the old-fashioned armies of Holland, Belgium, France, and England.

ALLIED INVENTIONS

Where did the Germans get the idea? The tank is an English invention, based on the American tractor tread. The development of the German Panzer divisions followed the principles of the United States Army's first Experimental Mechanised Force, developed by Major-General Adna R. Chaffer, who died recently.

The Germans also learned from the French expert on mechanised warfare, Colonel (now General) de Gaulle, whose ideas of offensive warfare were ridiculed by Petain and Weygand.

It is startling to recall that no major war weapon, or new basic use of that weapon, has been invented by a German. Dive-bombing was used first by the US Navy, later by the British Navy. The use of parachute troops was first suggested to General Pershing by General William Mitchell in 1917; after the war the French experimented with the idea, the Russians formed several parachute battalions which proved ineffective in Finland.

It remained for the Germans to develop really effective parachute troops, and in effective numbers. That, in fact, is the basic reason for German successes—men trained as specialists and in sufficient numbers to accomplish the job.

Before the war started, Hitler boasted of "secret" weapons. He had none, unless the magnetic mine and the troop-carrying glider were so regarded. The magnetic mine was a surprise, but the defence against it was based on a principle far outdating the mine, which was simply a demagnetising belt placed around ships.

It seems that the secret weapon possessed by the Germans was no more than plain commonsense and the ability to analyse any given problem, arrive at the correct solution, and then set the German nation's energies to work to produce the necessary equipment, in the meanwhile training men to operate it.

INEVITABLE RESULT

The result has been that, in every past land campaign, the Germans have always had the power to bring to any point more force than their enemies were able to oppose to it. The single exception has been the air battle over Britain late in 1940, when the British, though outnumbered five to one in the air, yet had sufficient fighting power and staying qualities to break down the German air attack. Intended to be overwhelming, it degenerated instead into an air war of attrition.

In view of the close co-operation we can expect in the future between the troops of America and Australia, it is interesting to consider recent developments in American ideas concerning air-infantry co-ordination.

A POSSIBLE ROLE FOR THE LIGHT PLANE

A month after German troop-carrying gliders proved to be one of the decisive factors in the capture of Crete, the US Army Air Corps decided to begin experimenting with gliders.

It bought a few, and plans to buy more. To quote an American journal:—

"I have heard it said that the United States Army did not wake up to the military possibilities for a long time, but it it takes a long time to set a large machine in motion" (evidently he was referring to the Army, not the gliders). "There may be many missions for gliders used for military purposes, but we must first go through one test after another and complete our development programme until we are just as adept in using them as the Germans. I can visualise readily many missions where gliders may spell the difference between success and failure."

A Piper Cub two-seat monoplane in flight. Our contributor suggests that such planes could be put to good use for observation and scouting purposes. Simple to fly, the pilots would not need to be highly trained and could be regular Army officers and NCOs. They could take over much of the work now performed by fixed observers and scouts on motorcycles.

If, late in 1941, the General could visualise so readily what the Germans visualised a decade or more ago, it might reasonably be asked: Why have the Americans bought just "a few"?

There has been no secret about gliders, and since the war began there has been no secret about their probable use as troop—and even as light tank—carriers. Such use was expected and was fully discussed in English and German technical aviation magazines.

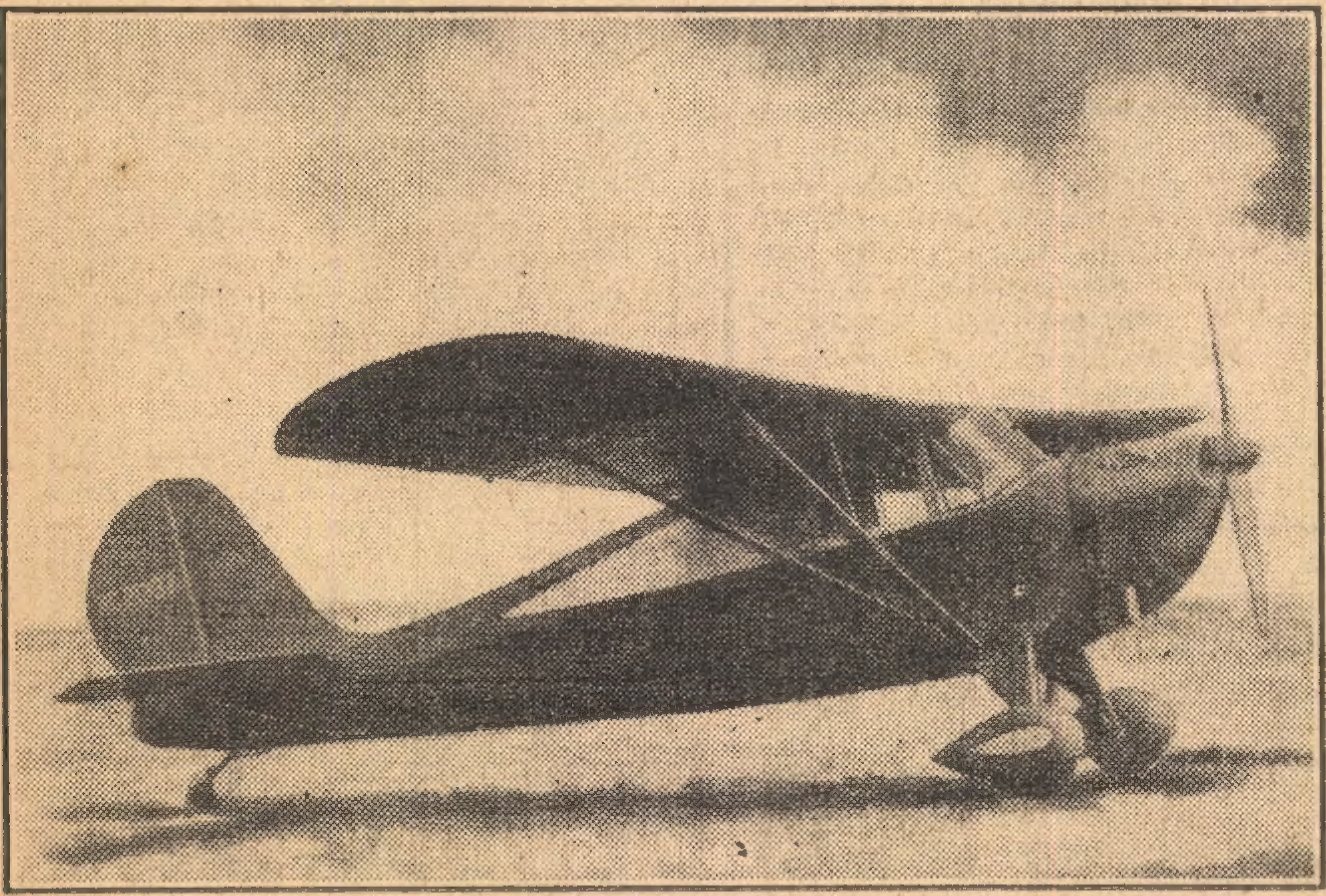
INVASION GLIDERS

In the threatened invasion of Britain the Germans were expected to use thousands of big gliders, towed in trains of from three to five by bombers and transports. Each glider was thought to be capable of carrying from 12 to 17 fully equipped troops.

Crete may or may not have been a rehearsal for the invasion of Britain or Ireland, but, by capturing Crete, the Germans have learned much by actual experience that the United States will find hard to duplicate with their "few" gliders.

The United States Army should not be discouraged in even its most feeble effort to become air-minded. But it must be said that the purchase of a few or even a few dozen gliders seems an extremely modest effort to be put forward by an Army Air Corps defending a nation of 132,000,000 people and which has undertaken such vast commitments in Australia and the Pacific.

Leaving the Army to struggle with its gliders, let us go on to another aspect of air-infantry co-ordination that the United States Army has overlooked until recently. We refer to the light plane.



Another light plane, the Aeronca Chief. Such light planes could scarcely be effectively armed, although they could carry a few small bombs. For defence they would have to make use of their slow speed, their manoeuvrability and "hedge hopping" tactics. Small planes of this type do not need prepared aerodromes and require only a minimum of upkeep.

THE LIGHT PLANE

Largely through the efforts of a representative of the American Piper Aircraft Company, who had been active in promoting military interest in Piper Cubs, seven Cub trainers were permitted to participate in the recently completed Second Army manoeuvres in Tennessee.

The small Piper Cub is a plane intended for use by the general public—the "Ford" of light aircraft, if it is understood that "Ford" applies from a mass-production aspect and carries no derogatory suggestion. The Cubs used were standard trainers powered with Continental 65-hp engines and equipped with two-way radio.

During the three weeks' manoeuvres, these light planes were used for direction of artillery fire, courier service, and liaison work in directing troop movements. According to high-ranking Army

(Continued on Next Page)

Over The Top—Surprise Tank Attack

By skilful use of cover and terrain, a force of tanks can often conceal their presence from observers on the ground until the last moment. Regular patrols by light planes over the forward enemy positions would make surprise attacks much more difficult to launch, since the observer would be in a far better position to see concentrations of tanks and troops.

officers, their performance has indicated "possibilities for future use."

USEFULNESS PROVED

The United States Army has budged slightly in the direction of the light plane. They found out, for instance, according to an official spokesman, that "the plane can be used as a means of securing enemy information in the immediate vicinity of the front lines, and we can also move our guns into positions against tank attacks more quickly than the tanks can move into position for attack."

With a light plane scouting ahead, an anti-tank gun crew will at least have information about the direction from which the tank is coming to attack them.

And that is something. But when the light low-flying observation plane is linked up as an integral part of every anti-tank gun and its crew—if it ever is in this man's army—then we'll have an anti-tank gun that can see over the top of the next rise, which, at present, it cannot do.

That is merely an adaptation of the German tank dive-bomber combination, and useful in defensive operations, though it doesn't alter the present war experience that the best answer to a tank is another tank, a bigger, better and nastier tank, supported by a better and nastier aeroplane.

THE MATTER OF DEFENCE

An objection to the light plane for nearby observation may be that it carries no defensive armament. Modern defensive armament for a two-seater does not mean one machine-gun on a mounting taken around in the slipstream by a perspiring observer, who can't hit an attacking fighter. It means a power-operated multiple-gun turret.

And that means too much weight for the light plane. Thus the light observation plane must rely for its sole defensive power on its manoeuvrability and lack of speed.

And that is not a defensive power to be passed off lightly by an enemy fighter pilot mounted in his 1000 to 2000 hp charger, capable of anything from an actual speed of 350 mph with full war equipment, to the manufacturer's estimate of "nearly 500 mph."

This eagle of the air sees the humble Cub creeping along just above the treetops (if he sees the little fellow at all, which is doubtful), so he dives on the supposed victim at 400 to 600 mph, according to who is doing the reporting.

> IT is interesting to note that, during the defence of Malaya, various flying clubs in the country organised a Volunteer Air Force, comprising 60 pilots and 40 Tiger Moth planes. Although unable to give air support to the troops, the light planes carried out valuable reconnaissance work, carried communications between Army camps and picked up survivors from service planes which had been shot down by enemy action.

Down he comes, right at the target, and, unless he starts pulling out half a mile up, he goes right through the Cub and the trees as well. If the light plane sees his attacker, he simply does a vertical bank and changes his course of flight, something the heavy and fast pursuit cannot instantly do.

Naturally, such a power dive would not be made by any fighter pilot in his right senses. He would probably try making shallow glides towards the target. Even so, the picture of a £5000 or £10,000 fighter ship being sent out to shoot down a Cub is rather ridiculous.

So the moment the Army Air Corps figures on using slow-flying observation planes, an opposing Air Force naturally would produce a fighter ship to combat those particular planes. And, quite naturally, the force with the observation planes also would be forced to build little fighters for the protection of their little observation craft.

This is mentioned as presenting an obvious "other side" to the light aircraft idea, which might easily be overlooked. In the releases which have been made to date about the light planes used for observation in the recent US Army manoeuvres, for example, all that is mentioned is the use of the planes, and no mention of possible opposition.

But opposition or a counter-measure to every military weapon is developed, sooner or later. So this time, as a helpful suggestion, it might be pointed out that, if any army is to have its little, slow observation planes, it also must have a necessary proportion of little protecting fighters.

And, this is a further argument for the US Army having its own aviation, the type that works in close contact with the Army. Such planes are properly auxiliaries of the Army, and should be flown by Army officers or non-commissioned officers.

A LESSON FROM THE GERMANS

The German Air Force has demonstrated not only its power as an independently acting bombardment force, but also its ability to subordinate itself to the needs of a ground force in perfect co-ordination, as in the plane-tank combination.

The US Army Air Corps, on the other hand, although it is a part of the Army, failed utterly to work out really effective co-operation between land and air forces, except in the limited field of artillery observation and reconnaissance, a hold-over from the last war.

Artillery observation is almost useless in moving warfare because the artillery usually lags behind advancing mechanised forces. Furthermore, while the German air force is entirely independent of army control, it yet had the foresight to build thousands of transport planes to carry air-borne German infantry anywhere it wanted to go.

The US Army Air Corps, as far as can be judged, hasn't more than enough transports to carry generals and colonels, and would have to seize the entire commercial air-line fleet if it wanted to take a sizeable part of the Army anywhere in a hurry.

The originator of the idea of light observation aircraft, a Major Adams, of the US Army, as an infantry officer is not much interested in the Air Corps. It is not equipped to do what he or any other infantry officer wants, even if it knows what he wanted, which is doubtful.

Mostly the Air Corps consists of bombing and fighting planes, with a proportion of observation and reconnaissance planes, which are supposed

to work in close co-operation with the infantry and artillery.

Actually, they have never had enough practice war manoeuvres to know whether they could co-operate or not, although it has been known for some time that the German air force and army spent many months of intensive training in ground-air co-operation before the German army and air force moved against Poland.

Major Adams' idea is that an infantry regiment should have as part of its equipment at least eight light planes, and every artillery battalion should have five. This is a minimum number for close-in air reconnaissance, directly under the command of the regimental and battalion commanders, and especially necessary during moving warfare, as distinct from a war of position, such as trench warfare in 1914-18.

MODERN INFANTRY

The entire conception of infantry has been changing since 1914, prior to which an infantryman was simply a soldier with a knapsack on his back, and a rifle and bayonet. When the regiment moved anywhere away from a railway, he walked. Motor cycles and trucks were fancy trimmings that interfered with his exercises.

Light artillery was part of the artillery, not of the infantry; and it usually wasn't where the infantry wanted it. Now infantry regiments have trucks, cars, motor cycles, more and more heavy machine-guns and light artillery, such as 37 mm. guns. They have everything but airplanes.

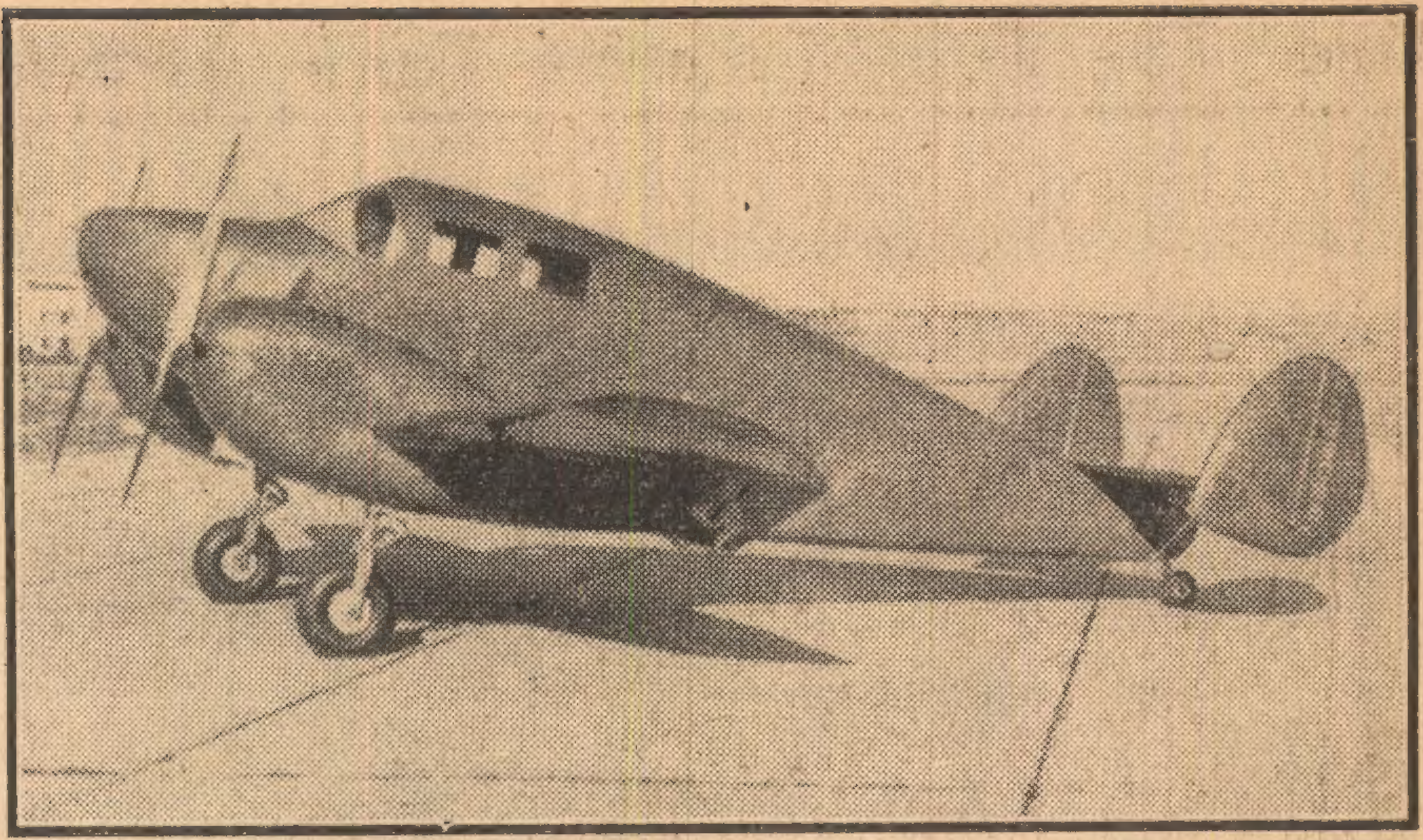
The light plane, as an integral part of an infantry battalion, would serve the same purpose as the periscope or a submarine. The light plane could get up and see what is immediately ahead and to the sides.

At present, this work is performed by motor cycles and scout cars; and their visibility is limited by the terrain over which they operate. The visibility of the plane is limited in height and distance only by the desire of its operator.

BETTER OBSERVATION

Light planes would be an ideal means of observation or scouting for staff officers and commanders of infantry and artillery units. The Chinese say one picture is worth a thousand words. If battalion commanders could hop into their own light planes at any time, and go take a quick look over the enemy lines and the country around about, they'd have an accurate picture of what lay ahead, instead of trying to piece it together from reports, which frequently arrive too late to be of much use in moving warfare.

These planes could be used to deliver advanced observers on hilltops or observation points, either by landing or by dropping a parachute soldier with his radio to report back to the commander. Information of the enemy's movements, information about the terrain ahead, information about strong points that should be blasted by artillery or dive-bombing—all of this is vitally necessary.



A light plane made mostly from moulded plastic mahogany plywood. Extremely simple in construction, the plane has no mechanical fastenings such as nuts and bolts; all parts are permanently joined by plastic compositions. Mounting two 65 horsepower engines, this model has a top speed of 142 mph, a cruising speed of 125 and lands at 46 mph.

Yet under present Army procedure, how is it obtained? By occasional, not continuous, reconnaissance by the Air Corps; by sending men ahead by motor cycle or on foot. In short, by using antiquated methods when modern ones are available.

The light plane would present no problems of maintenance, as with its simplicity of operation, a mobile workshop could service half a dozen or more light planes.

There is yet another possible use of the light plane. Flying at 100 mph over the treetops, it is a difficult target to hit. No matter how well an attacking tank may be warned of impending air attacks, the light plane loaded with bombs could be over, drop its "eggs" and be away in the space of a few seconds. A light plane, with only the pilot, could carry several small bombs of sufficient power to damage a tank enough to put it out of action.

Despite tank armor, the tractor treads still remain the tank's "Achilles heel." Heavier planes would obviously be more effective, but where are they to come from in numbers comparable to the light plane?

RAPID PRODUCTION

For the number of hours needed to produce one US Army Air Corps fighter or dive-bomber, with its engine, armament and equipment, at least thirty light planes could be built. Not "military" planes loaded with a hundred gadgets, guns, ammunition and whatnot, but light planes, just as they roll off the manufacturer's line, with light bomb-racks under their wings.

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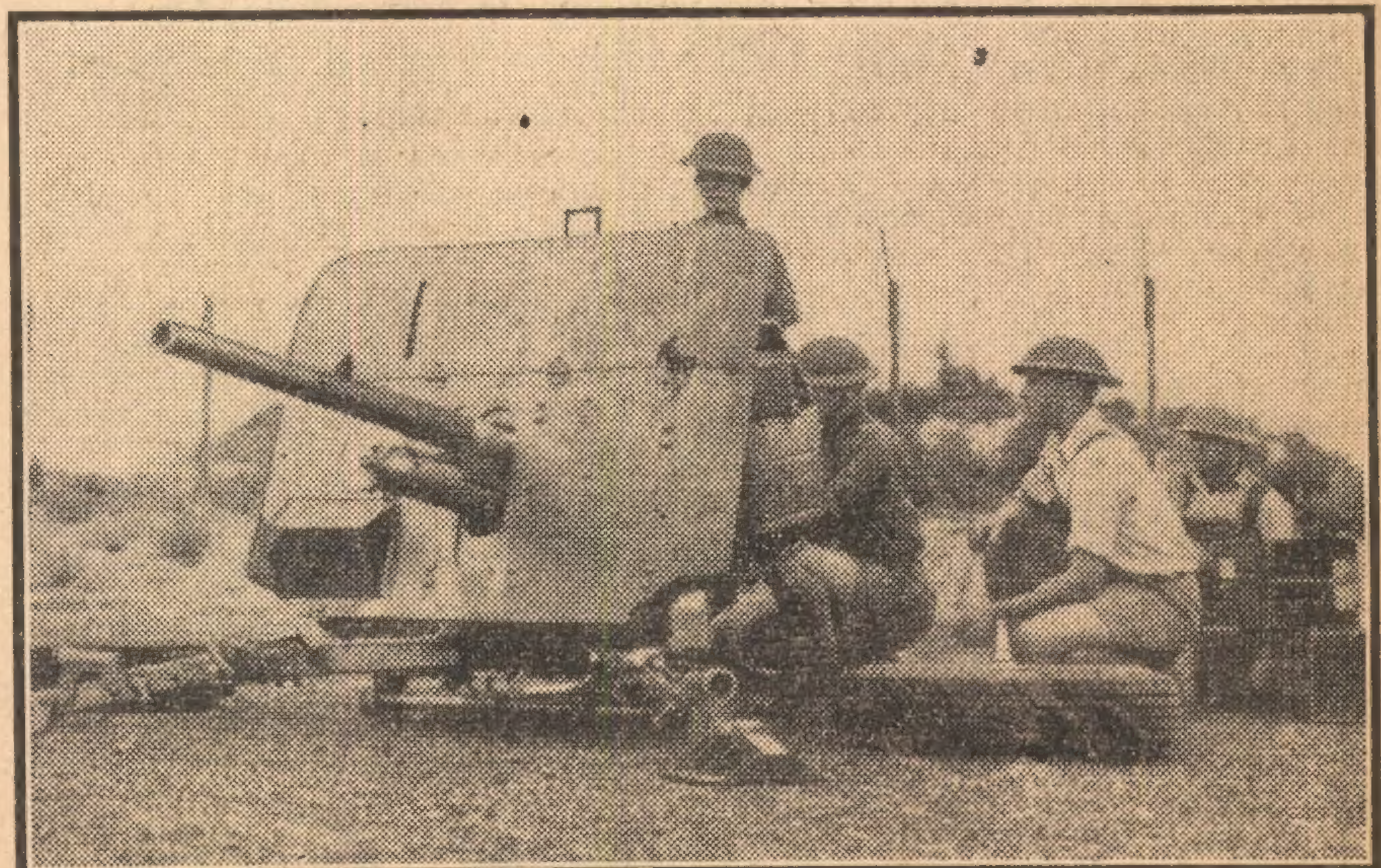
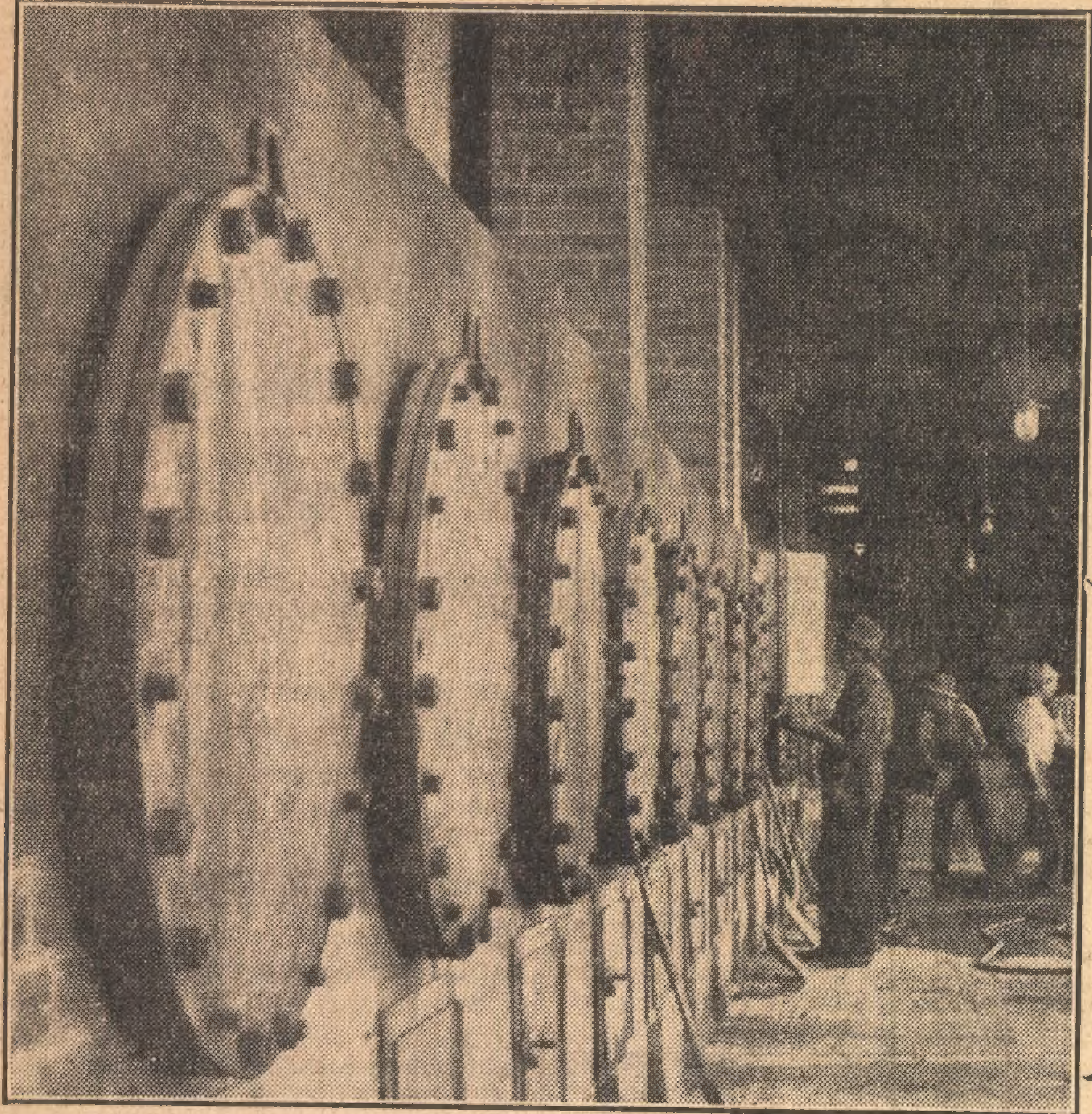


The anti-tank gun is a very useful weapon—if it happens to be in the right place. The job of having the appropriate weapons in the right place is made much easier if the commanders have accurate and up-to-the-minute knowledge of the enemy's movements.

THE PRODUCTION OF OIL FROM SHALE



Looking on the front of a row of horizontal retorts at a shale oil plant "somewhere in Australia." As explained in the article, the use of horizontal retorts takes full advantage of secondary decomposition of the shale and eliminates the necessity for the elaborate "cracking" process.

For her supplies of lubricating oil and liquid fuel, Australia is almost entirely dependent on overseas sources. The present war situation, with the shortage of shipping and the loss to the enemy of the Indies oilfields, raises again the vexed question of oil production in Australia. In this article, Mr. H. Gotting discusses the method which he evolved some years ago for extracting oil from shale.

THE Army, the Navy, the Air Force and the industries, which back them up, must have oil in vast quantities. Interrupt their oil supplies and all four will lie in helpless idleness.

The Allies are planning to use Australia as a vast base for an offensive in the Pacific. Tens of thousands of land vehicles, planes, and ships are being accumulated to this end.

Australian industry can keep the equipment in trim, can feed and clothe the men, but the all essential oil must come across thousands of miles of dangerous ocean in ships which are far too few in number.

The lesson is obvious. Even if we cannot produce all the fuel oil we need in the immediate future, what resources we have should be developed at once and to the limit. It is dangerous for any nation to have to rely on outside sources for this indispensable commodity.

Undoubtedly, the ideal supply of oil for any country is that obtained from wells or bores. This is often referred to as "well" or "flow" oil, but is more commonly known as petroleum.

However, not every country has this valuable asset, and, unfortunately, Australia happens to be one of these countries. Although drilling operations have been going on in several localities for some years, no oil of any consequence has ever been located.

by H. Gotting

There are plenty of people who claim that there is oil in Australia, but the simple fact remains that no one has yet succeeded in bringing it to the surface in really useful quantities.

Therefore, with the exception of a few million gallons of benzol, produced from coal, and the comparatively small quantity now being produced from shale, all our oil has to be imported.

HUGE IMPORTS

In the case of petrol alone, this has amounted to something like 360,000,000 gallons per annum. As mentioned earlier, there is always the possibility to be faced that this country might, for a time, be completely cut off from overseas oil supplies.

In the absence of well or flow oil, the only alternative remaining to us, in this event, would be to supplement what stocks we might have on hand by all the other means at our disposal.

These would include the destructive distillation of shale and coal, both of which are available from very large deposits, and the production of power alcohol from waste cereals, from refuse, and from the production of sugar.

Of these, oil produced from shale is probably the most important, since it gives the most fuel per ton of material. The discussion, from this point, will centre around the production of oil from this source.

At present, a comparatively small number of plants are in continuous operation producing petrol, power kerosene, and diesel oil. However, this vast potential source of oil in Australia is lying almost untouched.

VAST SHALE DEPOSITS

To quote Dr. Bradfield:

"We have any quantity of shale in this country going to waste. There's enough to make us independent of external petrol supplies if the Government also encouraged the production of synthetic fuels."

Another eminent engineer, Mr. J. Fielder, of the NRMA, states: "We could produce all the petrol we need. Japan is doing what we should have done—producing 60 per cent. of her own domestic requirements, and she has not been as well fixed up by Nature with coal and shale resources as Australia has been."

There are large deposits of shale in New South Wales at Capertee Valley, Burragorang Valley, Clyde River, Walgan Valley, Baerami, Mittagong, Newnes

CAN IT SOLVE AUSTRALIA'S PROBLEM?

and other places. In addition there are extensive deposits in Queensland and Tasmania.

At Alpha, near Rockhampton, the shale deposits, four miles in extent and four feet thick, are stated to be capable of producing the very high figure of 150 gallons to the ton. Here small retorts are being installed.

VARIOUS DEPOSITS

At Gladstone, where the Queensland Government is boring, there are shale deposits more than 200 feet thick and capable of producing 40 gallons of crude oil to the ton, or about 12,000,000 gallons to the acre.

At Mackay, the body of the shale mass is about 200 feet thick and tests have shown that the lowest gallonage is 26 to the ton, the highest 62 and the average about 40.

The Mines Department has estimated that there are about 40,000,000 tons of oil-bearing shale in New South Wales alone and about 50,000,000 tons of rather lower quality in Tasmania. It may well be that there are vast deposits of shale as yet undiscovered.

The nature and origin of oil-bearing shale is, in itself, an interesting study, but rather outside the intended scope of this article. However, we can well afford to consider the chemistry of producing oil from shale.

PRODUCTION PROCESS

Although it is called oil shale, the shale actually does not contain any oil as such but a substance called "kerogen" or pyro-bitumen.

Under the effect of heat (pyrolisis), this first breaks down into bitumen, a semi-solid asphaltic like substance. This is called primary decomposition.

If the bitumen is subjected to further heat, it breaks down into gas, crude oil and water. This is called secondary decomposition.

The residue after secondary decomposition contains fixed carbon, ash and mineral matter, such as silicon, iron oxide, alumina, lime, magnesium, sulphur, &c.

The crude oil, according to the method of retorting, is either a heavy, thick, dark-colored liquid containing little motor spirit, or a thin, light-colored liquid containing a large quantity of motor spirit.

VERTICAL OR HORIZONTAL RETORTS

The thickening of the oil in the former case is mostly the result of undecomposed bitumen being present. The reason for this is that there is not much secondary decomposition in the type of retort used for producing this type of oil.

The particular retort referred to is the Pumpherstone or Scotch variety—vertical and continuous. The resultant crude oil is either "cracked" to motor spirit or treated to produce by-products such as kerosene, diesel oil, lubricating oil and paraffin wax.

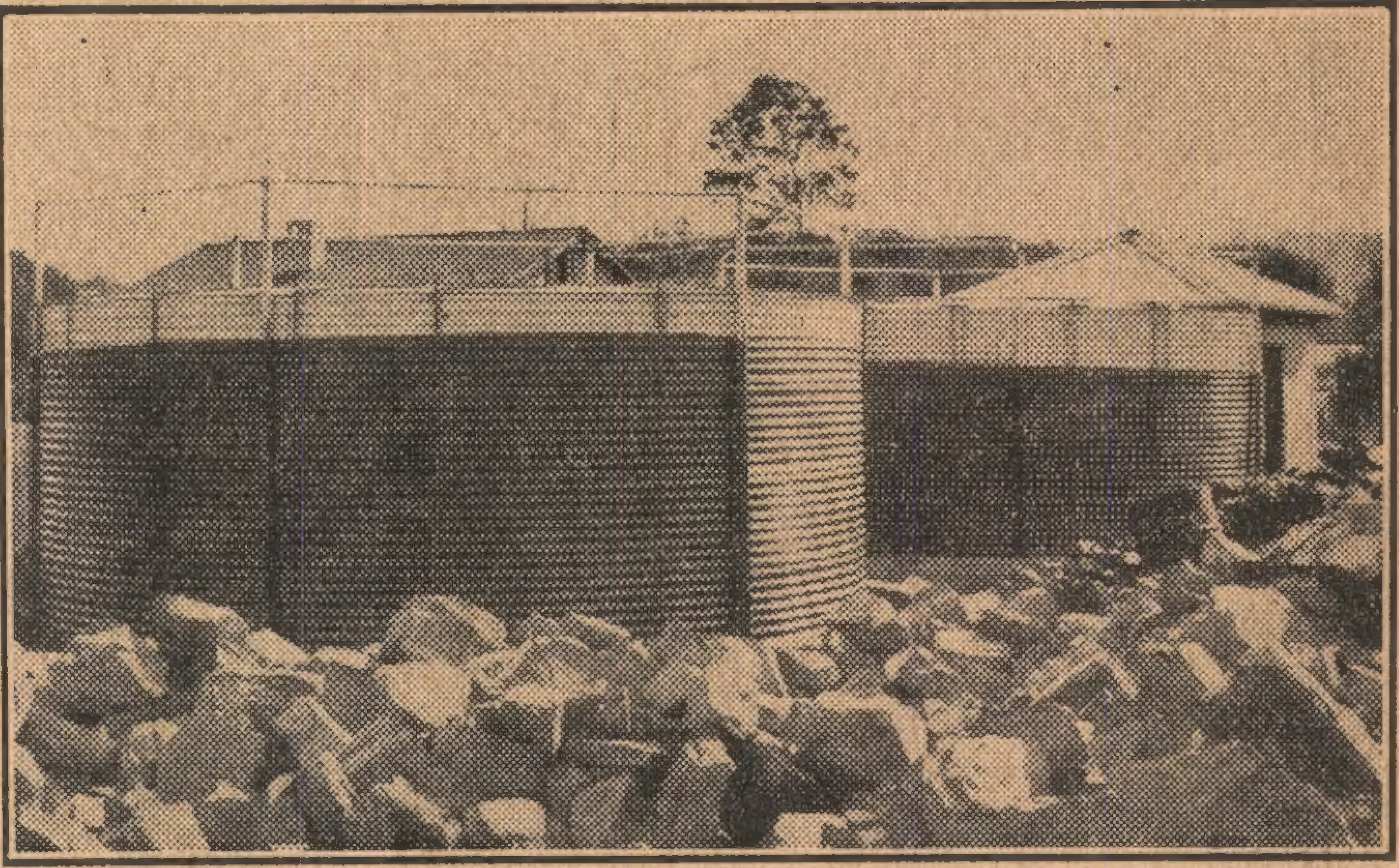
These retorts are the type now in use at Glen Davis where the crude oil is cracked to motor spirit. "Cracking" is a process for producing motor spirit from heavy oils.

The cracking process would take too long to escribe here in any detail. Suffice it to say that it requires elaborate and extensive apparatus and a large retorting plant to keep the cracking plant in flow. For economical operation, at least a thousand barrels of crude oil are required daily.

In the Gotting process this cracking plant is not required, as the horizontal retorts produce a very light crude oil, the process taking full advantage of secondary decomposition.

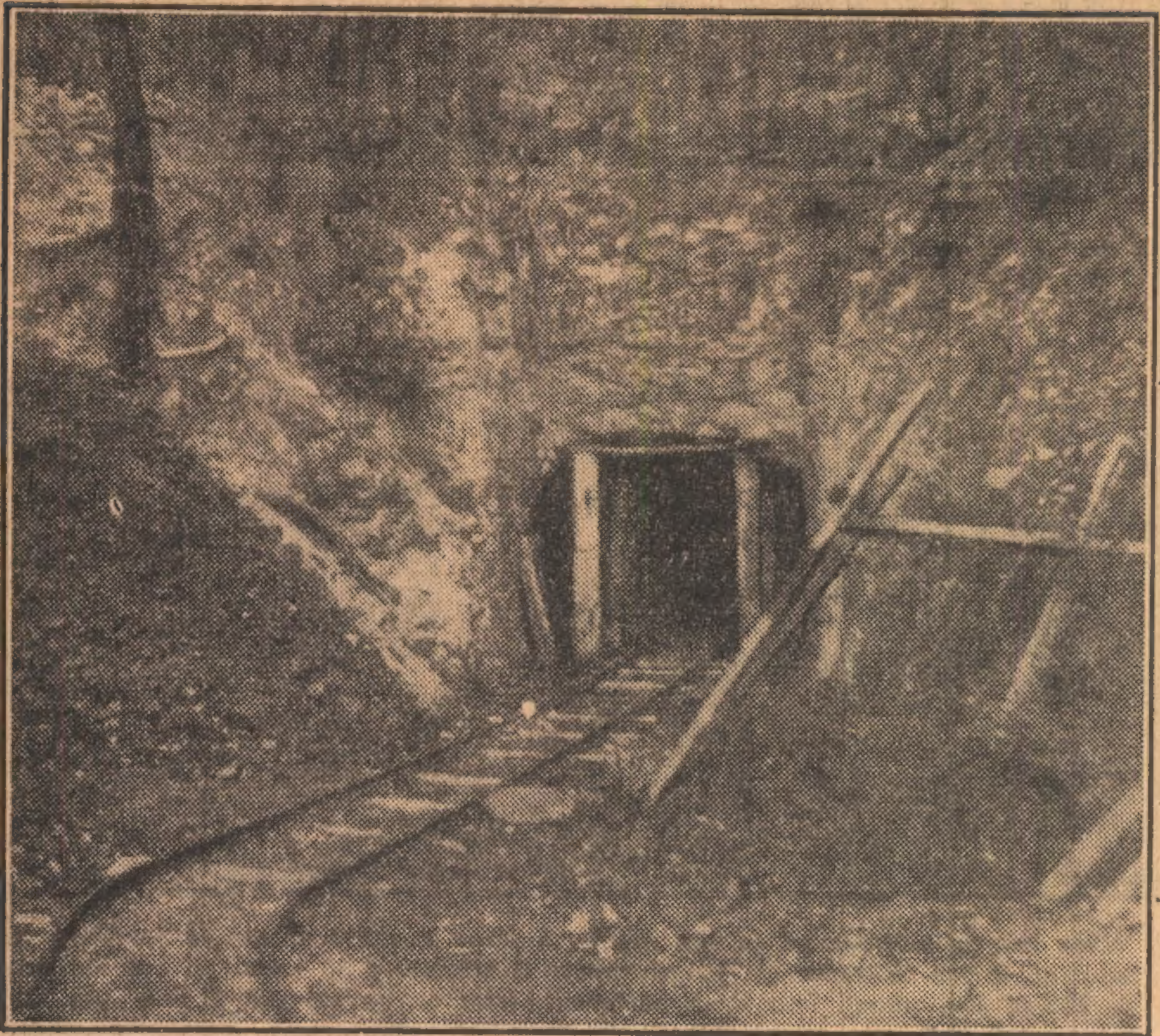
There is actually no undecomposed bitumen in the oil produced by the

(Continued on Next Page.)



When the shale is heated in the retorts, a large quantity of gas is produced in addition to the oil vapour. The oil vapour is condensed to crude oil but the gas is filtered and passed into these containers, later to be used as a fuel. In the foreground are the large lumps of shale as they come from the mine.

Portion of the distilling plant. The crude oil is heated in this, the vapour being condensed and the resultant liquid collected in appropriate containers. Depending on the temperature, the liquid which comes off is classified as motor spirit or power kerosene. The heavy oil left behind is diesel oil. The products of the still have to undergo further chemical treatment before being fit for use in internal combustion engines.



Gotting process, the crude oil consisting of motor spirit, kerosene and diesel oil only. A plant using this process can be set up on small field, where the setting up of the elaborate cracking plant would not be economical.

The plant required in the Gotting process consists roughly of the following: (1) horizontal retorts, where the oil is produced from the shale; (2) topping stills for taking off the "tops," as the motor spirit and kerosene is called; (3) agitators for chemically treating the oils; (4) stills, where the final product is produced. In addition, there are sundry items, such as storage tanks, pumps, piping, meters, &c.

CHEMICAL TREATMENT

The chemical treatment consists of treating the oils with caustic soda and sulphuric acid of various strengths, according to what oils are being treated. Motor spirit, kerosene and diesel oil each require different treatment for the removal of aromatic acids and sulphur compounds.

The fixed gas produced during the retorting is passed through a medium heavy oil to pick out any light spirit which may happen to pass over and is then piped to gas containers, later to be used as a fuel for heating stills and retorts.

YIELD PER TON

Under typical conditions, one ton of shale produces just over 60 gallons of crude oil. This yields 37.5 gallons of motor spirit, 13 gallons of power kerosene and nine gallons of diesel oil. In addition, the ton of shale, during the retorting process, produces 1500 cubic feet of gas at 1500 BTU.

In conclusion, it may be helpful to consider briefly a typical plant, now in operation and using the Gotting process.

The shale is mined from the hillside and transported to the plant on lorries and a narrow gauge truckway. The shale varies in color from dark grey to almost black. It has a clean, shiny surface, is odorless, and is light to handle. When set alight, it burns with a red, smoky flame.

It is broken up into fairly small lumps and shovelled into one of many horizontal retorts. The retort is then sealed and the contents heated.

The products of the heating are an oil vapor and a natural gas. These are passed through a condenser, where the oil vapor condenses to a crude oil. The natural gas, unaffected by the condenser, is bubbled through a medium heavy oil, as mentioned earlier, and then stored in a gasometer.

When necessary this gas can be used as a fuel to heat other retorts and stills. When the process is complete, the residue in the retort is partially combustible and can also be used as a fuel.

The crude oil obtained from the retorts is heated in a still, the temperature being carefully watched. As the temperature slowly rises, motor spirit comes off first and is piped to a suitable container.

At a certain critical temperature the liquid coming off is diverted to another container. The process continues until a third critical temperature is reached, at which point the process is interrupted.

The liquid, which comes off over the lowest range of temperature, is motor spirit; that over the intermediate range of temperature is power kerosene. The remainder is diesel oil.

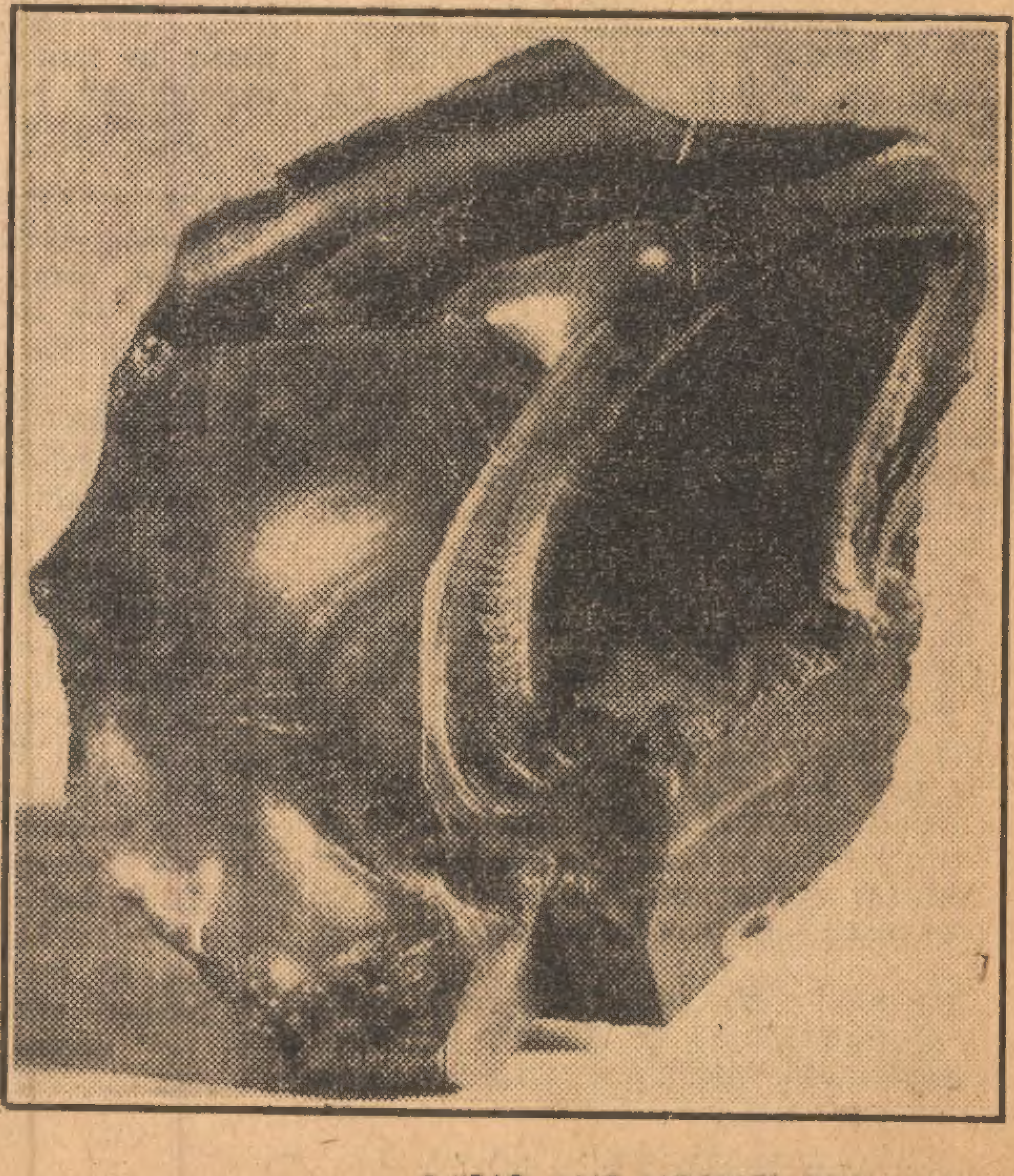
Following this separation comes the chemical treatment, which has already been discussed.

IN CONCLUSION

I am now working on a new principle of distillation which is giving remarkable results, the fractions produced having excellent color and odor characteristics and requiring very little refining.

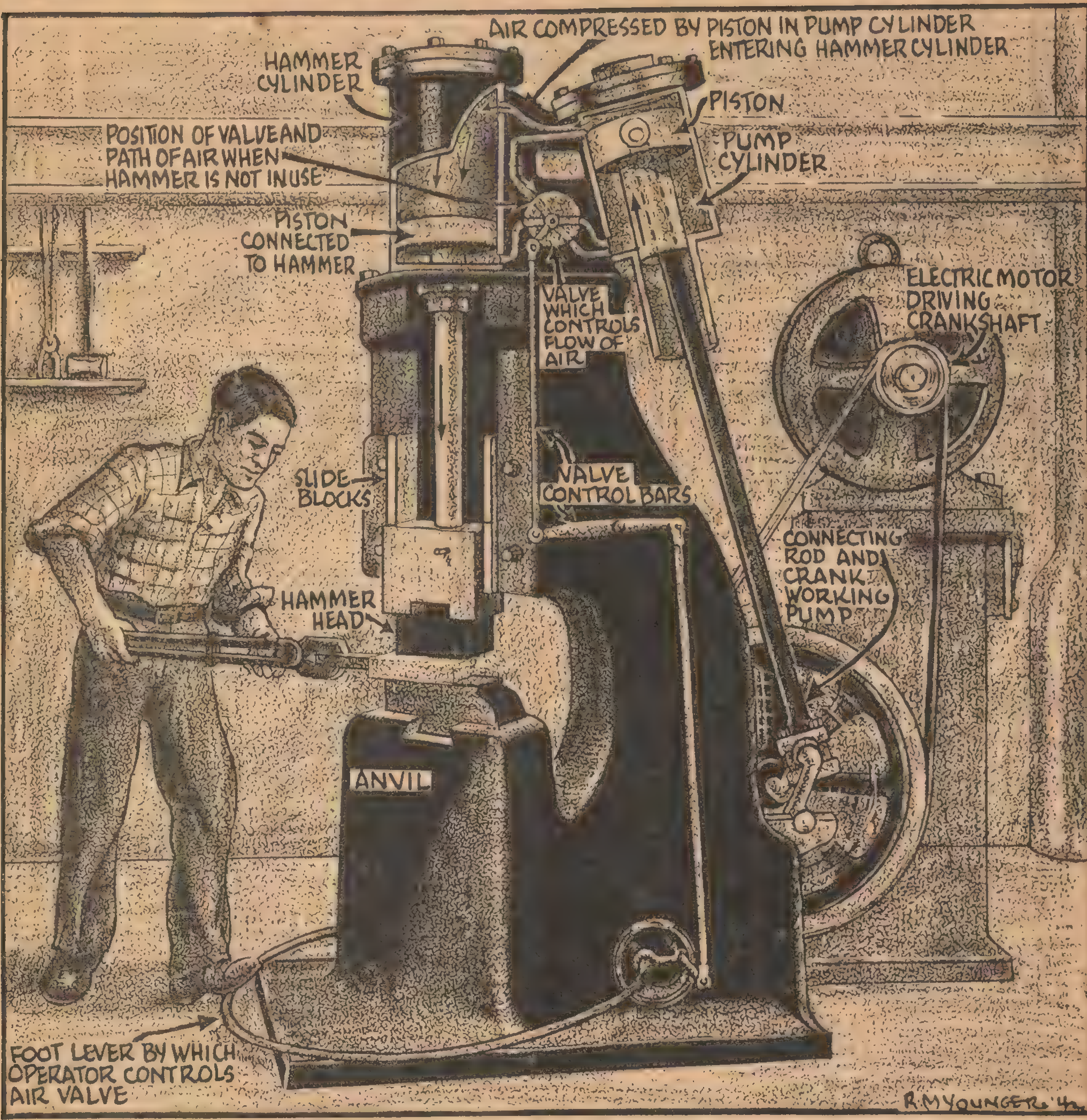
I might mention that the refining of shale oil is much more difficult than the refining of flow oil. If the chemical treatment is not done most carefully, high losses, bad color and poor keeping qualities are the result. There is a lot of research work yet required in the refining of shale oils.

With one or two possible exceptions, the vast deposits of oil shale in Australia are still only being worked on a very small scale. There are very good reasons why this country should push ahead with the local production of oil so that we might be less dependant on overseas supplies of this vital commodity.



The oil bearing shale varies from mid grey to almost black in colour. When taken from the mine it has a clean shiny surface and is less brittle than coal. The shale is light to handle and, when lighted with a match, it burns with a sooty smoke and an odour not unlike that of boiling tar.

"HOW IT WORKS"—BY R. M. YOUNGER



THE PNEUMATIC HAMMER

THE pneumatic hammer plays an important part in the forging of iron and steel into armaments and munitions today just as, in happier times, it played an important part in forging iron and steel into machines and gadgets which brought happiness and comfort.

The pneumatic or compressed air-hammer, which is sketched here, is a wonderful machine. It is powered by electricity, and is more convenient than the earlier steam hammer.

Internal workings of the pneumatic hammer can be followed from the sketch.

Power for the machine comes from the electric motor (right centre of the sketch). Through a crankshaft and connecting-rod, this motor provides power for the piston within the pumping cylinder.

The pump cylinder is connected by passages at top and base to another cylinder, in which a piston moves up and down. This latter cylinder is the hammer cylinder, for the piston in it is connected to a shaft with a hammer at the end.

The passages governing the flow of air between the cylinders are controlled by a valve, which is worked from the operator's footbar. The sketch

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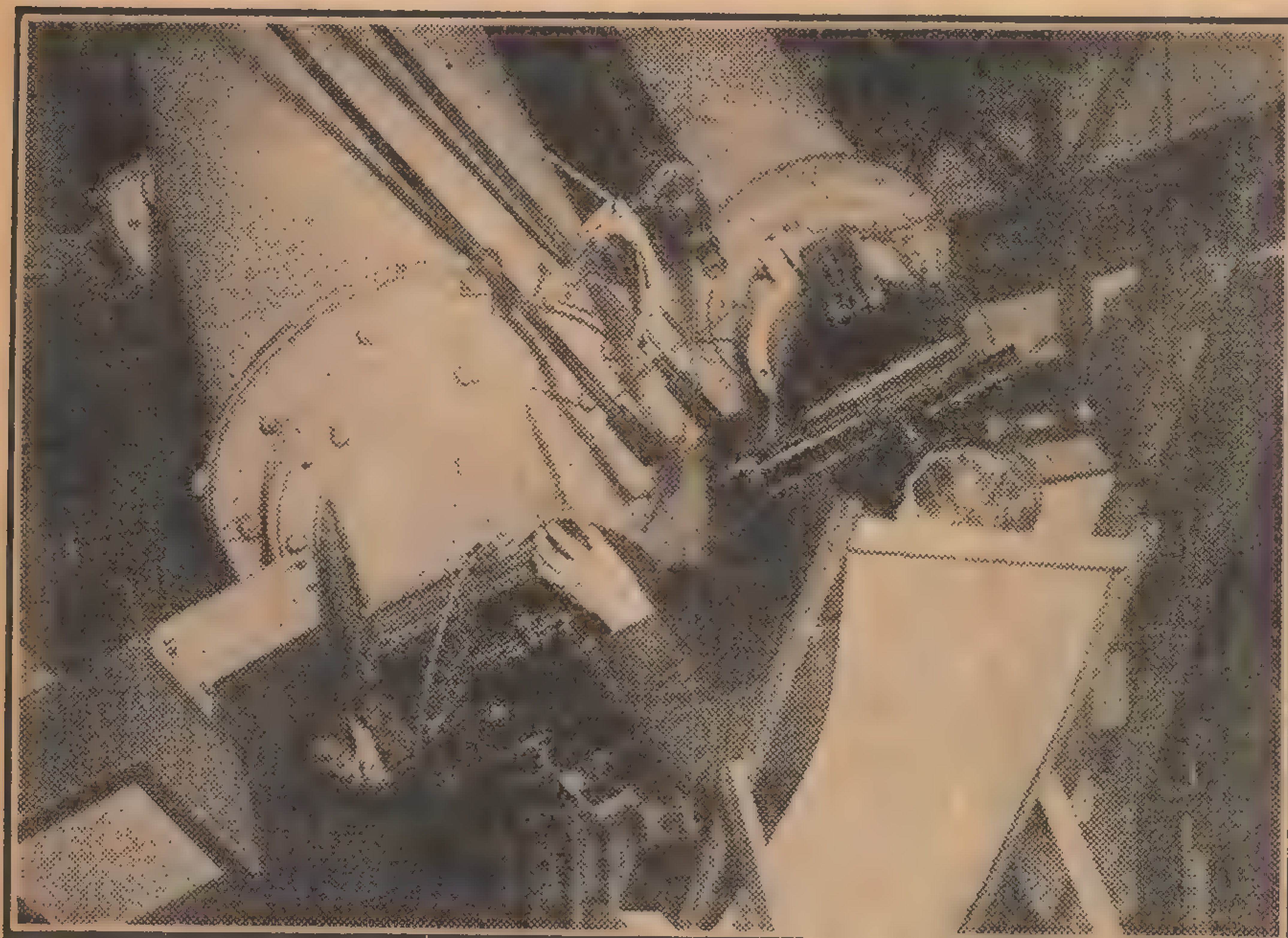
STUPENDOUS FIGURES FROM ASTRONOMY



When this picture was taken in February, 1931, scientists were in the act of photographing the smallest planet, "Eros," which, in that particular month was "only" 16,000,000 miles from the earth. These photographs and observations from the Greenwich observatory enabled scientists to make certain necessary corrections as to the distance of all other planets from the earth and from each other.

Astronomy is the oldest of all the physical sciences. How old no one seems to know. Certain it is, that this science was studied right back to prehistoric times, as is indicated by the construction of the Great Pyramid of Egypt. For this building is admitted to be the oldest in the world, and the knowledge of astronomy indicated in the construction of it could not have been acquired other than by careful study.

by **Calvin Walters**

IN my younger days, one of my greatest ambitions was to be an astronomer. In fact, so intense was the desire, that I took to making telescopes—much to the chagrin of my parents—who were deprived of the use of their kitchen for weeks on end because of the litter of glass and cardboard tubes.

After long and arduous labor, I succeeded in making a reflecting telescope. The view of the heavens through that instrument was a never-to-be-forgotten sight. Saturn's rings had nothing on the rings I found round, not one star, but all of them. One of the first stars I looked at was square in shape and, of course, visions were conjured in my mind of the great discoveries that had been made by other astronomers before me.

Imagine my amazement when I turned my head slightly, so that I looked through the eyepiece at a different angle, and the same star assumed a triangular appearance. Next, it was the shape of an ellipse, but never could I get it to look round.

It was at that stage that I began to realise that something must be wrong. Then began more pulling to pieces, more grinding of lenses, more mess in the kitchen.

Finally, I began to see that, to make a good telescope, requires a fair knowledge of the following arts: Optics, geometry, trigonometry, glass working, carpentry, tinsmithing, fitting and turning, plumbing and self-control.

Don't let this discourage any budding astronomers from attempting to make a telescope if they want to. Maybe I am a dud at making things, but personally I prefer to save up and buy a telescope.

Mention was made earlier of the Great Pyramid, and a few facts about this wonderful structure would not be amiss.

The four sides of the building face towards the four points of the compass with such accuracy that no error can be detected by the most delicate of instruments. The base is truly level and exactly square. The exact geometrical centre of the land surface of the earth is at the point where the pyramid is built.

If a line is drawn from the apex of the pyramid down each of the two corners facing the coast, and, if these lines were extended to the coast, the resultant triangular area would exactly enclose the delta of the River Nile.

Inside the pyramid there is a gallery that slopes downwards from the north face to the deepest central chamber, and this gallery is at such an angle that it points to the star that was nearest to the pole when the pyramid was built in about 3700 BC.

It is no wonder that the pyramid is looked upon as of supernatural origin, and is used by "prophets" to forecast the events to take place in the future.

To attempt to write a comprehensive article on astronomy in such a limited space as the editor allows me would be mere presumption. I have, therefore, chosen for my subject that important but almost unknown force called gravitation.

This may sound paradoxical but it is true. Gravitation is important because it holds the universe together. It is unknown in the sense that to this day we don't know what it is and what causes it.

SIR ISAAC NEWTON

You all know the story of Isaac Newton. This chappie was supposed to be walking through an English orchard wondering what it was that kept the moon running round the earth without performing other tricks such as turning upside down or careering off into space never to return.

Very conveniently at that critical moment an apple fell off a tree, and Isaac began to think harder than ever. Might not the force that caused the apple to fall to the earth be also the force that keeps the moon in its orbit by pulling it forever towards the earth.

Perhaps, he thought, this force was all pervading to the uttermost bounds of space, and thus the planets and the stars are kept in their orbit by a

GRAVITY HOLDS THE UNIVERSE TOGETHER

precise balance of this force which Newton called gravitation.

It was some years after Newton's theory that the idea was definitely proved. After mathematical calculation, the distance of the moon from the earth was obtained. These figures were used to calculate the action of gravitation on the moon, and this calculation was found to agree exactly with the moon's course. The same calculations were used in relation to other celestial bodies and were proved correct.

NEWTON'S LAW

Thus, the famous law of gravitation was formulated by Newton. This law says: "Every particle of matter in the universe attracts every other particle with a force in the direction of a straight line joining the two, whose magnitude is proportional to the product of the masses, and inversely proportional to the square of the distance between them."

So the earth attracts the apple and the apple attracts the earth. A grain of sand attracts the rock and the rock attracts the grain of sand. And so all the planets attract one another and the sun attracts all the planets. The implication of this is at once evident.

If this theory is correct, it is obvious that there must be some order in it all. There must be some relation in the size and position of all the planets that keeps them moving in the same order forever. This is true. The planets are so arranged in respect to their mass and distance from each other and to the sun, that the force of gravity is distributed in such a way that none of the planets can move from their course.

AN ILLUSTRATION

Imagine a metal ball upon which is exerted the force from two magnets, one large magnet and one small magnet. If the small magnet was brought near enough to the ball, the ball would fly to the small magnet. Should the large magnet be brought near the ball the extra strength of the large magnet would cause the ball to leave the small magnet.

On the other hand, if the magnets were arranged so that the larger was farther away from the ball than the smaller, then we would have a condition where the force acting on the ball would be equal from either direction and the ball would not move.

Thus, the positions of the planets are arranged and the force of gravity is precisely balanced between them.

This law of gravitation is used in an attempt to discover new planets and other heavenly bodies.

The three great laws of planetary motion formulated by John Kepler are as follows: (1) The planets move, not in circles, but in ellipses with the sun at one of the two principal foci. (2) As the planet moves round the sun, the line from sun to planet passes over equal areas in equal times, and thus the planet moves faster when nearer the sun than when farther away. (3) There is a constant proportion between the time that a planet takes to go round the sun and its distance from the sun.

A truly remarkable photograph of the planet Saturn obtained through the 36-inch telescope in the observatory atop Mount Hamilton, California, USA. Nightly observations of the heavens are made in this and other observatories all over the world. Sometimes a single discovery will mean months of work for a large staff of scientists.

It was on these laws which Newton pondered and which led him to replace an idea of Kepler's that the planets were steered on their course by celestial spirits, by a force of gravitation.

This force of gravitation, acting along the line between the planets and the sun, controls the planets as it controlled the moon. Newton maintained that as his apple fell to earth, so the moon and meteors try to fall to the earth and the earth and comets and planets try to fall to the sun. In fact, all things to try to fall to all other things.

It was Kepler's third law, as stated above, that led to the discovery of the planet Neptune. According to this law there is a constant proportion between the time that a planet takes to go round the sun and its distance from the sun.

DISCOVERY OF NEPTUNE

Accordingly, when the planet Uranus was found to travel much faster and farther between the years 1800 and 1810 than it did between 1830 and 1840, it set astronomers thinking.

A theory was propounded that an unknown planet was exerting a pull on Uranus, which accelerated the path of that planet at the earlier date and retarded it after it had passed a certain point in 1822. (See diagram.)

Calculations were made, and the result led the astronomers to turn the telescope towards the place where they thought the unknown planet should be, and there he was. Neptune, a mere two thousand millions of miles from the earth, and a thousand million miles beyond Uranus.

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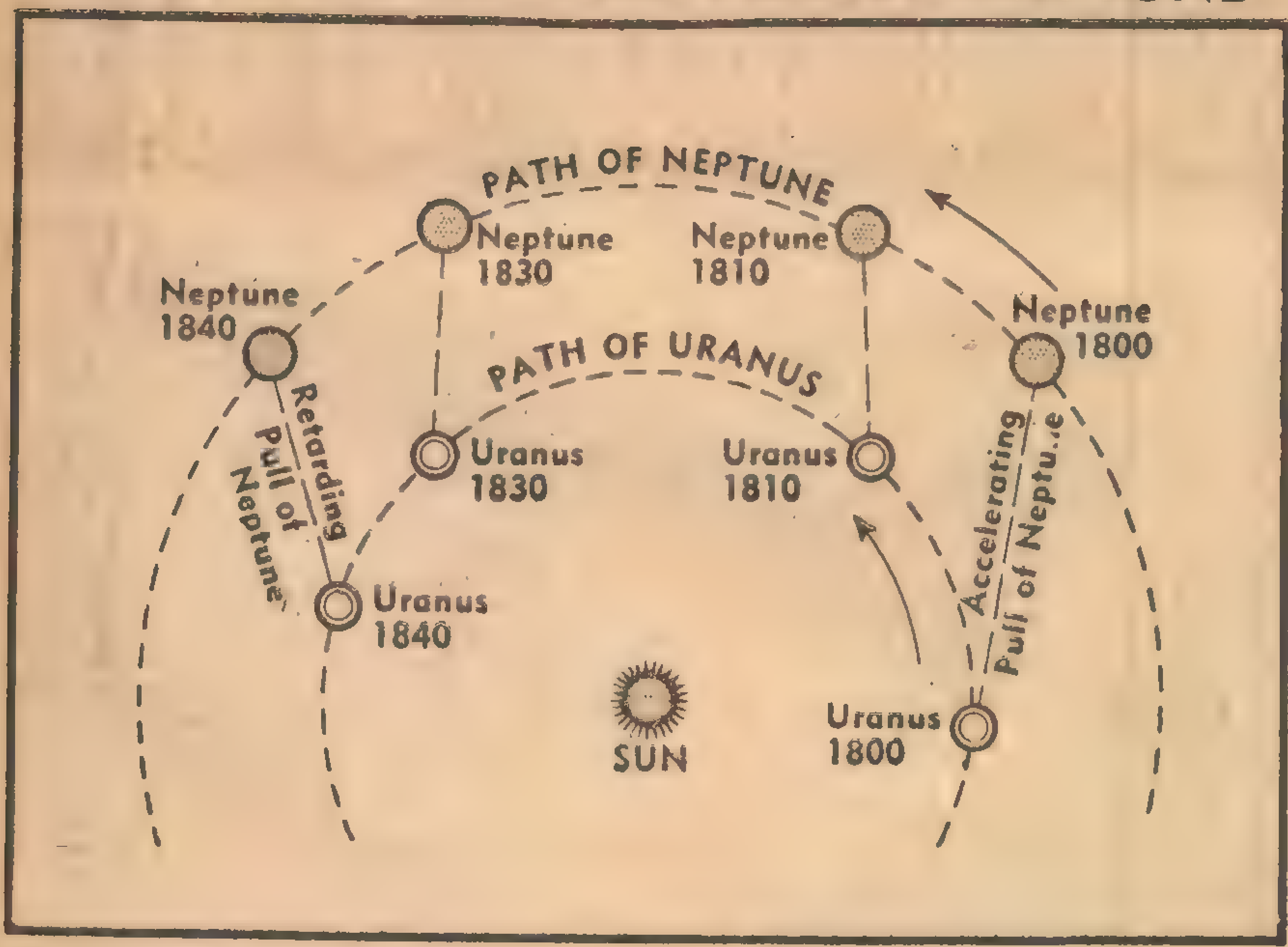
DISCOVERY OF THE PLANET NEPTUNE



Illustrating how the planet Neptune came to be discovered. Between 1800 and 1810, the speed of the planet Uranus about its orbit was noticed to be much greater than normal. It was more or less normal between 1810 and 1830, but decreased considerably between 1830 and 1840. Pursuing the theory that Uranus was being influenced by another planet, scientists ultimately discovered the planet Neptune.

Thus were two laws proved at one stroke. Kepler's third law of planetary motion and Newton's law of gravity.

CONTINUOUS FORCE

Gravitation acts continuously. It is not like light, heat or sound. The latter waxes and wanes, but the force of gravity is always constant. It has no speed as far as we know. It is instantaneous.

If we consider that the greatest speed that we know of is the speed of light, namely 186,000 miles per second, and that even this enormous speed involves thousands of years throughout the vast distances of space, we can see the tremendous importance of the instantaneous character of the force of gravity.

If speed was involved in the workings of gravity things would not be as they are. But gravity is simply here, there and everywhere at the same time.

GRAVITY CANNOT BE MODIFIED

Gravitation pays no attention to obstacles. Try as we may to modify it, we do no more than reach a stumbling block. It can be measured and a change of mass or distance between two bodies brings about an effect that is certain and constant.

But no change of physical condition or temperature or chemical combination, &c. will influence the force of it. We, therefore, cannot abolish it, even for a moment.

Our measures of weight are determined by using the force of gravity of the earth. In other words, the strength of the earth's pull on an object is the weight of that object. Thus the further from the centre of the earth an object is taken the less it will weigh.

For instance, if you weigh an object at the poles you would find it to weigh less at the equator, as the earth is flatter at the poles than at the equator and thus nearer the centre of the earth.

VARIATION IN WEIGHT

Similarly, the same object would weigh less at a great height from the surface of the earth or on a high mountain. The difference in weight is about 1-2000 of the weight for every two miles of elevation.

An article weighing 16 ounces at the temperate zone would weigh 15.9 ounces at the equator, 16.2 ounces at the poles, 4 ounces at 4000 miles above the earth and 53-1000 ounce at the distance of the moon, namely 240,000 miles.

Here is a curious fact, which seemingly violates the law that the nearer the centre the greater the pull. The distance from the surface of the earth to the centre at the temperate zone is about 4000 miles. Half-way down, that is 2000 miles, our pound weight would only weigh 8 ounces.

The reason for this is that the 2000 miles above our weight would be tending to pull it upward and thus acting against the downward pull.

Gravitation, according to our usual estimates, is not a very powerful force. This may seem a strange statement to make, when we consider its capacity to hold the balance of power, so to speak, of the universe.

There are other forces such as molecular forces of cohesion and capilliary attraction that can counteract the force of gravity in a sense.

A sealed envelope held with the addess side upwards will not be torn open by the force of gravity as the cohesive action of the gum will be sufficient to counteract the force of gravitation between the flap and the earth.

OPPOSING FORCES

Likewise, capilliary attraction will cause the sap to flow upwards in a plant against the force of gravitation. The walls of the heart in the weakest of new-born infants will send the blood coursing upwards against the force of gravity.

Man can hold a ball in his outstretched hand. But all these things do not prove that we can oppose the force of gravity or nullify its effects.

What it does prove is the fact that gravity is only one of the forces of nature, and, further, that this force is constantly present as is evidenced by the fact that it requires effort, if we wish to accomplish or arrest any movement along the line of its action.

Immediately any opposing force ceases to act, the force of gravity comes into play and the flap of the envelope falls downwards. The sap of the tree sinks and the blood in our veins falls back against the valves of the heart.

Try to fly an aeroplane in a vacuum. There is no opposing force of the air against the wings or propeller to counteract the force of gravity and a crash results.

A FEW FIGURES

To give some idea of the forces at play that enable the universe to go on its way without alteration, to speak in a general term, I give some figures to fire the imagination of the budding astronomer.

The unit of distance used in astronomy is the light year and is the distance that light travels in one year. Light travels 186,000 miles per second. Multiply this by the number of seconds in a year and the result is one light year. It is approximately six thousand million million miles. The universe as we see it has a diameter of 1,400,000,000 light years, and a mass of ten billion billion suns (329,000 times that of the earth).

The weight of the earth is 6000 million billion tons. Some of the stars have a diameter of 400,000,000 miles. One of the Nebula, the Great Nebula in Andromeda, is 1,000,000 light years away, that is six million million million miles

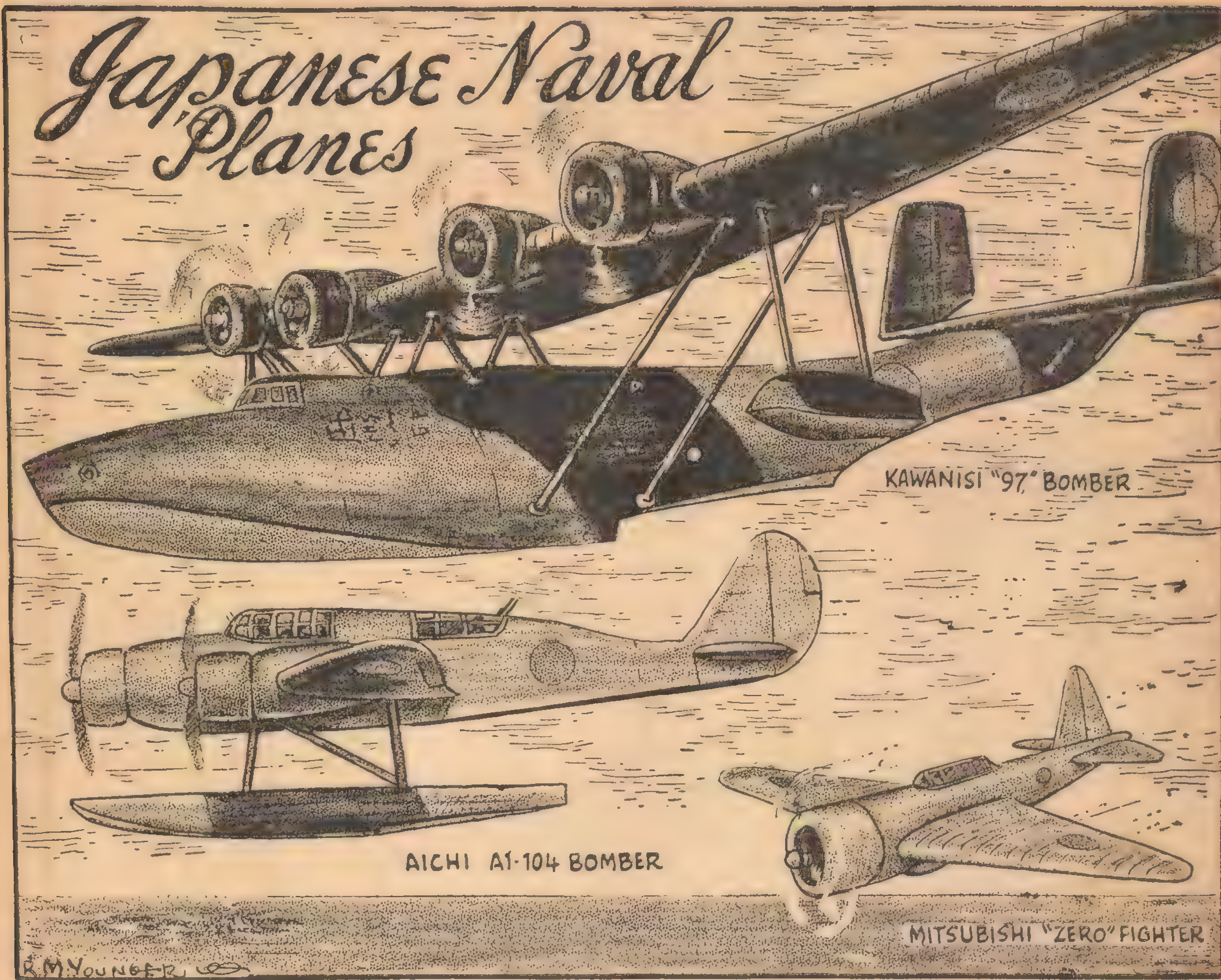
There are other universes beside our own. This Great Nebula in Andromeda

(Continued on Page 17)

WIDE RANGE RECEIVER

IN the vast majority of radio receivers the fidelity is severely limited by "side-band cutting," as a result of the comparatively high selectivity. On page 21 of this issue we describe a TRF receiver, which has been designed with the primary object of giving the best reproduction of the local stations.

JAP TARGETS FOR ALLIED PLANES



Events in the Pacific war have proved that the Japanese can fly dangerously well, and that they have good planes. However, now that the Allies have "front line" machines in action against the Japs in our Near North, the enemy is suffering considerable losses. Sketched here are three Japanese naval planes which have been in use in the war:

AT the top is the Kawanisi 97 naval bomber, a flying-boat which is an obvious copy of the US Sikorsky Clipper. Despite its four radial engines, this rather cumbersome machine has not a very high speed. Points of the design are the two angular fins and extensive external strut-bracing.

The fuselage is of the hull type, and there is a float beneath each wing. The "97" is regarded highly by Japan. It has been used on long-distance raids on Port Moresby, and earlier on Rabaul. However, the toll of "97's" being taken by the RAAF is growing.

The "97" is a military version of the flying-boats which the Japs used on the Yokohama-Dilli air route opened last year. Armament includes a rear-gunner's position in the extreme end of the tail unit, behind the fins.

The Aichi A1-104 (centre left) is a three-engined float-plane bomber. One engine is mounted in the point of the long nose; the others are in the wings. Each of the two floats is strutted with N-shaped bracing. A crew of three is carried and defensive armament includes a rear-firing gun.

Finally, the Mitsubishi "Zero" (or "O") fighter (lower right) is a plane that has proved a powerful Jap weapon over much of the Pacific war zone. This naval fighter is a single-seat machine. The design is characterised by sharply-tapered wings and a tall triangular fin.

It has been revealed that the "Zero" fighter is fast and highly manoeuvrable. Its top speed is about 340 mph. The planes are armed with a variety of cannon and machine guns. Men who fought against these machines said some carried at least three cannon.

It appears that they are variously armed—some with one cannon, others with two; and some with both cannon and machine-guns. This rather indicates that the Japs are short of air-cannon, and mount what they can, as the guns and planes come to hand.

The successes which Allied aircraft have scored in sorties have proved our front-line machines can deal very effectively with any of Japan's aircraft.

WORK OUT YOUR OWN MATHS PROBLEMS

In last month's issue we dealt very fully with Ohm's Law, which, as you will probably remember, enabled us to determine either the voltage, current or resistance in a circuit when only two of these factors are known. Now we propose to follow on from this point and show you how the power dissipated or heat developed in a circuit can be readily calculated by the application of suitable formulae.

by C. E. Birchmeier

AS we mentioned previously, every substance actually consists of electrons and protons. All the protons, together with some of the electrons, are contained in a centre fixed nucleus around which the balance of the electrons rotate.

The nature of the atomic structure and the arrangement of these rotating electrons determines the conductivity or, alternatively, the resistivity of that substance. The application of a voltage to the conductor tends to force these free rotating electrons to "drift" or move in a definite direction, thus causing an electric current to flow.

Now if there are insufficient moving electrons, the current will be continually impeded by countless collisions between the moving electrons. This opposition (or "molecular friction" as it is frequently called) to the current will naturally cause part of its energy to be used up and this energy is usually dissipated in the form of heat. That is, we have electrical energy converted into thermal or heat energy.

POWER CALCULATIONS

Since the power or heat dissipated in a circuit or component will naturally vary with circumstances, it is essential that some means be available for calculating it. Unless this can be done, too much heat may be developed in a component, with disastrous results.

On the other hand, if the component selected is capable of dissipating the heat likely to be developed in the circuit, then no damage can possibly result under normal operating conditions.

The power developed in a circuit is measured in watts and is the product of the voltage across and current through a circuit or component. Thus we have our fundamental relation with which we can calculate the number of watts developed in any circuit:

$$P = E \times I \quad \ldots\ldots\ldots \quad (1)$$

in which

P equals the power in watts,
E equals the applied EMF in volts.
I equals the current in amperes.

Thus, the filament of a 5Y3-G rectifier has 2.0 amps flowing through it under a pressure of 5 volts in order to heat it to red heat. The filament is therefore using electric power at the rate of 2.0 multiplied by 5.0 equals 10 watts.

Should the current be given in milliamperes, as may frequently be the case, then our formula becomes:

$$P = \frac{E \times I}{1,000} \quad \ldots\ldots\ldots \quad (2)$$

in which

P equals the power in watts.
E equals the applied EMF in volts.
I equals the current in milliamperes.

Taking the case of a 6.3 volt valve drawing 300 milliamps of heater current, the power developed would be:

6.3 multiplied by 300 divided by 1000, equals 1.89 watts, or almost 2 watts.

SECOND FORM

However, both the voltage and current may not always be known and it is necessary to derive other formulae. From Ohm's Law we know: E equals I multiplied by R, so that, by substituting this in formula (1), we can obtain the form:

$$\begin{aligned} P &= E \times I \\ &= I \times I \times R \\ &= I^2 R \quad \ldots\ldots\ldots \quad (3) \end{aligned}$$

Thus, in a circuit where the current and resistance are known, the wattage can be easily determined by squaring the current in amperes and multiplying the result by the resistance in ohms.

If the units are given in ohms and milliamperes, then the following formula must be used:

$$P = \frac{I^2 R}{1,000 \times 1,000} \quad \text{or}$$

$$P = \frac{I^2 R}{1,000,000} \quad \ldots\ldots \quad (4)$$

If we have a 50 m.a. flowing through a resistance of 2000 ohms what power will be developed. If you work it out with the aid of formula (4), you will find that the answer is 5.0 watts.

You will also notice from this formula that, if the resistance were to be given in megohms the formula would revert to:

$$P = I^2 R \quad \ldots\ldots\ldots \quad (5)$$

in which

P equals the power in watts.
I equals the current in milliamperes
R equals the resistance in megohms.

THIRD FORM

From our basic formula (1) we can still obtain another form by simple substitution. Since from Ohm's Law we know I equals E divided by R, we can use this in place of I in formula (1). Thus we have:

$$\begin{aligned} P &= E \times I \\ &= E \times \frac{E}{R} \\ &= \frac{E^2}{R} \quad \ldots\ldots\ldots \quad (6) \end{aligned}$$

Thus, if the known voltage in a circuit is squared and divided by the resistance in ohms, the result will be the power in watts developed in that circuit.

What power will be developed in a circuit having a d.c. resistance of 50 ohms, with an applied voltage of 10 volts?

Work it out by formula (6) and you

UNIT CONVERSION TABLES

To convert:

microwatts to watts	divide by 1,000,000
milliwatts to watts	divide by 1000
microwatts to milliwatts	divide by 1000
watts to kilowatts	divide by 1000
kilowatts to watts	multiply by 1000
watts to milliwatts	multiply by 1000
watts to microwatts	multiply by 1,000,000
milliwatts to microwatts	multiply by 1000

will find the answer to be 2.0 watts.

Should the resistance be given in megohms instead of ohms then the formula becomes:

$$P = \frac{E^2}{R} \times \frac{1}{1,000,000} \quad \ldots \quad (7)$$

After a careful study of the above formula and examples, you should have no difficulty in calculating the wattage in any circuits irrespective of the units used. As you will probably notice, all formula can be obtained from the basic formula (1) simply by substitution and/or multiplication. Thus, once this form is memorised the remainder can be easily determined.

Whilst dealing with the wattage of a resistor, &c., there is another relationship which is useful to know. It frequently happens that the wattage of a resistor is known, together with the resistance in ohms, and it is desired to determine the maximum permissible current it will carry. This can be calculated from the following formula:

$$I = \sqrt{\frac{P}{R}} \quad \ldots \quad (8)$$

That is if we divide the wattage by the resistance in ohms, and then extract the square root of this number, the final result will be the safe current in amperes.

Suppose, for example, you wish to obtain the maximum current a 100 watt, 25 ohm resistor can handle.

$$I = \sqrt{\frac{P}{R}}$$

$$= \sqrt{\frac{100}{25}}$$

$$= 2.0 \text{ amperes.}$$

Alternatively, we may have a case where the wattage dissipated and current in amperes is known, but it is desired to determine the resistance values in ohms. In this case we use the formula:

$$R = \frac{P}{I^2} \quad \ldots \quad (9)$$

in which

R equals the resistance in ohms.
P equals the power in watts.
I equals the current in amperes.

AN EXAMPLE

Find the resistance of a circuit where the power developed in heat is 100 watts and the current is 5 amperes.

$$R = \frac{P}{I^2}$$

$$= \frac{100}{5 \times 5}$$

$$= 4.0 \text{ ohms.}$$

As a matter of safety and to ensure long life, resistors are generally operated at from 25 per cent. to 50 per cent. of their maximum watts dissipation rating and at about 75 per cent. of their maximum current carrying capacity rating. Such use makes plenty of allowance for poor ventilation conditions as are frequently found in normal receivers.

When there is no danger of damage to other parts from the heat developed in the resistor and where the ventilation is good it is permissible to use higher percentages.

TAPPED RESISTORS

Another point to be remembered is that the watts dissipation of a resistor is based on the supposition that the current flows through the entire resistance. If the resistor has tappings and the full current flows through only a part of the resistor then the watts rating is proportionately lowered.

Because of this, care should be taken to ensure that the maximum permissible current for the resistor is never exceeded for any portion of that resistor.

As the watt is a rather small unit of electrical power for use in practical work, there is another form. This is the kilowatt (KW) equalling 1000 watts and is used to express large amounts of power.

To change kilowatts to watts multiply by 1000. To convert watts to kilowatts divide by 1000. For reference we might mention 746 watts (nearly 3/4 kilowatt) equal one horse-power.

IN CONCLUSION

In conclusion, it should be mentioned that all the foregoing formulae, as well as those mentioned last month, apply particularly for direct current circuits. They also apply for alternating voltages and currents provided the values referred to are the RMS values. However, that is another story, and you will have accomplished much if you get a grip of the formulae for direct current only.

The examples given herewith have been based on the foregoing formulae and you should have no difficulty in working them out.

SEE IF YOU CAN SOLVE THESE:

1. If 5 m.a. plate current flows through a 100,000 ohm resistor, how much power in heat must the resistor be capable of dissipating?

2. Assuming we have an output transformer with a d.c. resistance of 400 ohms with 50 m.a. flowing through it, what amount of heat will be dissipated?

3. A power supply unit supplies 250 volts to an output valve requiring 50 m.a. plate current. Find the power developed and the apparent resistance of the valve. What will be the bias voltage if a 200 ohm bias resistor is connected in the cathode circuit?

4. The screen dropping resistor is .05 meg., and the current flow 10 m.a. What must be the wattage rating of the resistor? What is the voltage drop across this resistor?

5. If there is a 100 volts drop across a 20,000 ohm resistor what power will be developed? What will be the current flow in this circuit?

6. What is the voltage drop across a .025 meg. resistor with 5 mills current flow. What will be the power dissipation in this circuit?

7. The plate and screen current of an output valve are 40 and 10 m.a. respectively. What value bias resistor will be required to give 15 volts bias? What will be the power dissipated in this resistor.

YOU WILL FIND THE ANSWERS ON PAGE 49

STUPENDOUS FIGURES FROM ASTRONOMY

(Continued from Page 14)

is one of them. It is a colossal universe of thousands of millions of stars.

The light from this universe started coming here 1,000,000 years ago. Other universes are fainter in brilliancy and are 140 times farther away than Andromeda. The light from these started to come here 140,000,000 years ago.

THE SUN

The sun is 93,000,000 miles away and has a temperature of 6000 degrees at the surface and an estimated temperature of 40,000,000 degrees at the centre.

The number of stars in the galaxy is estimated at 100,000 million. Speaking of the sun again, the pressure in the centre of the sun is so high that a football would have to be pumped up to a pressure of 6,000,000 tons to the square inch to stay up. The sun loses 300,000,000 tons by weight by radiation every minute.

So now go out and look at the stars and realise what infinitesimal creatures we are in the universe, always growling and fighting one another because we can't have as much of this insignificant little planet as the other fellow has. Look at the billions and billions of square miles of universe as yet "untouched by human hand." I wonder? But that is another story!

NEW STRATOSPHERE PLANE

At the Farmingdale, Long Island, factory of the Republic Aviation Corporation, a new US Army plane designed to pursue enemy bombers at an altitude of 35,000 and 40,000 feet is being constructed. The Army Air Corps plan to build 1000 of these machines. The new plane, which will be in the 400-mile-an-hour class, will be the first single seat military aircraft to be equipped with the secret turbo-charger for its engines. It will be as large as a small transport plane and will weigh in excess of 11,000lb., in contrast to the 6000lb. of ordinary pursuit machines.

ITEMS OF NEWS FROM A WORLD AT WAR

Consolidated Bombers

LONG-RANGE bombers of the type necessary to carry an offensive war to the enemy already are rolling from the mechanised assembly lines of the Consolidated Aircraft Corporation's new plant at San Diego (California).

This plant was created less than three months after the contract was awarded.

Newspapermen who inspected the factory later commented that "output already is reaching quantity production."

It was revealed that 90 per cent. of workers at the plant had had no experience when hired. Women comprise a large proportion. They work alongside the men and receive the same pay for the same type of work.

Experts do not believe it likely that bombers ever will be produced on a mass scale similar to motor cars. They point out that 400,000 man-hours are required to product a four-engined bomber, compared with 800 for a car.

* * *

Animal Blood For Humans

ANIMAL blood will be used in the United States soon for transfusion into human bodies.

A revolutionary advance in methods of processiing animal blood is nearing completion.

The work is being carried on by Dr. J. B. Porsche, of the chemical research department at Armours, famous Chicago meat works.

Chemical research experts believe Dr. Porsche's process will solve the problem of emergency transfusion.

NEW BOMBS, NEW BOMBERS, NEW BLITZ

A SIGNIFICANT news paragraph, published during the month reads as follows:

Did RAF bombers, in the great two-day raid on Essen, use the new mystery giant bombs to which Lord Halifax recently made guarded reference in Washington?

The raid—described at the time as greater than any German blitz on England — completely "Coventrated" the big German industrial and munitions centre.

Germans admit that the biggest British bombs were so powerful that they wiped out entire blocks of buildings.

About 500 RAF planes participated in the attack. The heaviest bombs, at least 4480-pounders, were carried by the new Douglas Boston bombers.

Britain's 4480lb. bombs are 20 times bigger than the bombs used by the Japanese in the attack on Pearl Harbor. Bigger and more powerful "secret" bombs will make them pygmies, Lord Halifax said.

High Altitude Pills

JAPANESE fliers are taking pills of benzedrine, enabling them to withstand extremely high altitudes, according to a theory advanced by the American Society of Experimental Biology.

Scientists say experiments have proved that rats which have received similar treatment can withstand heights up to six miles.

Vital Metals From Australia

BRITAIN and America are now relying almost wholly on Australia for certain vital metals.

Minerals most urgently in demand are: Tin, zinc, lead, wolfram and scheelite (basic metals of tungsten used in making special steels), zircon (used in making zirconium for munitions), and rutile (used in welding).

Wolfram supplies from China and Burma are now almost completely cut off from Great Britain and America, and without tungsten the armaments industries would be largely crippled.

Now Australia is supplying Great Britain with all tungsten ores above her own requirements, but a large quota may now be diverted to America.

Canberra officials are perfecting plans to develop immediately extensive wolfram deposits in Central Australia and to increase production in Tasmania and elsewhere.

Australia was now meeting practically all her own tin requirements, it was stated.

But a vast expansion of tin mining is being planned to offset part of the Malayan production lost to the Allies.

Australia has always exported large quantities of zinc and lead, but, in these metals also, production is to be stepped up to meet new demands caused by the fall of Malaya.

Australia has large bauxite deposits, and may send ore to America as back loading on munition ships.

* * *

BRITAIN'S NAVY MEETS THE CHALLENGE

Despite the growing importance of air power, the job of protecting Britain's life lines still falls largely upon the Navy. The above picture shows some of the secondary armament aboard one of the new KING GEORGE V class battleships.

Tank versus Submarine

THE first battle between a tank and a submarine has taken place in the Mediterranean.

Honors went to the tank.

Tanks to reinforce the Tobruk garrison were being taken around the coast in barges.

An Italian submarine opened fire on one of the barges.

The crew of the tank on the barge immediately manned their posts, and fired a 2lb. armor-piercing shell at the submarine.

The Italians got the shock of their lives. They thought they had an easy target.

The submarine ceased fire immediately and dived.

* * *

British Glider Pilots

THE War Office, in announcing the formation of an Army Air Corps, discloses that the newest unit of Britain's striking force is a regiment of glider pilots, which will be the first to be brought within the scope of the Air Corps.

"Air Umbrellas" In Australia

IN the event of air attack Australia would be protected by a series of "air umbrellas," according to a recent statement by the Minister for Air, Mr. Drakeford.

Recent operations at Darwin and Port Moresby had proved the efficacy of the system, which provided for the maximum defensive and offensive force in the most important areas of Australia, he added. It gave more effective protection to air striking forces, Army troops, industries, communications, and the civil population.

* * *

Owen Gun For U.S. Soldiers

LARGE numbers of Australian Owen machine-guns will shortly be made available to United States forces in training camps in Australia.

US officers have seen the gun in action on a Sydney range.

Its performance has impressed them deeply.

Officers of General MacArthur's staff have arranged for special tests of the gun.

The Army Minister announced early last month that all machine tools required for mass production of the gun had been provided.

Large quantities of the guns have been ordered.

* * *

Jap Secret Radio

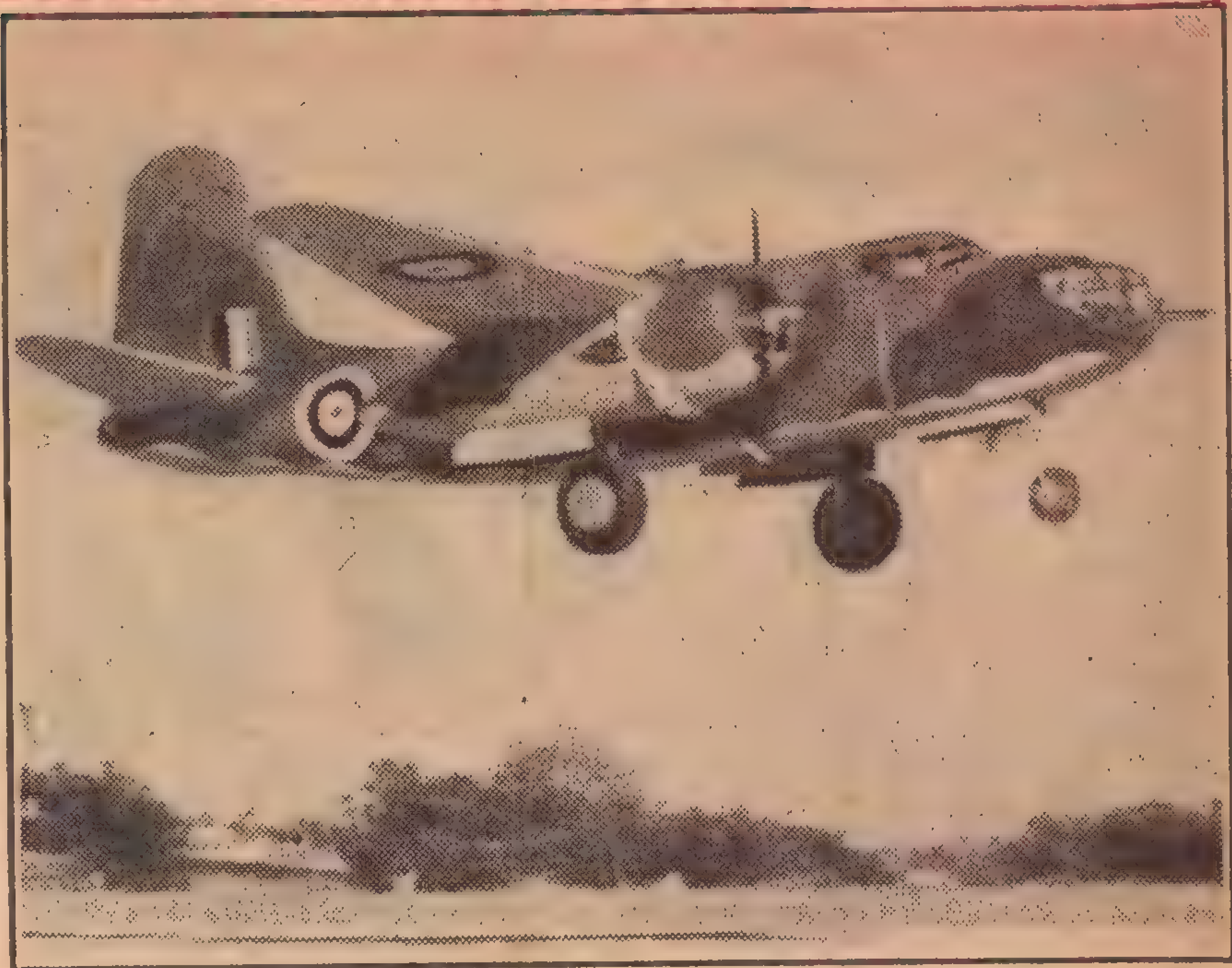
FEDERAL police have arrested 16 Japanese found operating a secret radio near the United States border at Chihuahua City.

The police have also rounded up in Mexico City 30 Germans and Italians, including the alleged Gestapo Chief for Mexico.

Officials have announced that they are taking increasing measures to counter Fifth Column activities and espionage.

FEATURE STORY

BOSTON BOMBERS POUND GERMAN BASES



Douglas Boston bombers have received frequent mention in the news of late. The bombers present an unusual appearance as they land or take off. However, once in the air, the tricycle landing gear retracts and the plane assumes a more conventional appearance. The fighter version of this plane has won fame as a night fighter, being appropriately named the "Havoc."

Naval Dock Smashed

THE big dock at the German-occupied naval base of St. Nazaire has been made useless, and photographs reveal some of the damage done by the recent British raid.

The dock's lock gate, 30ft. thick, can not be repaired for a year, so badly was it blasted.

The destroyer Campbelltown, which was used as a block-ship, the forepart being filled with explosives to blow up the lock, had disappeared.

It is hoped that half the ship is still under water blocking the dock entrance.

The built-in lock mechanism was destroyed and so was the pumping house.

Air-Raid Shelters For Warships

THOUSANDS of workers are building huge air-raid shelters for German warships at strategic points along the coast of Europe, Berlin radio says.

"These shelters are the second part of a chain of mammoth buildings along the coastline," the radio adds.

"Hitler himself designed these giant fortifications to protect the coast against sea-borne invasion and parachutist attacks in the rear.

"The first lines of defences consists of vast gun emplacements, entrenchments, pill-boxes, and a network of strategic roads. This part of the work is finished.

"At huge central depots, workers keep machines going day and night mixing eement, which pipelines carry to building sites."

* * *

RUBBER AND THE WAR

JAPAN has captured areas producing 90 per cent. of the world's raw rubber supply.

There are stocks in Britain and on the water, and Britain is busy developing synthetic processes.

But there will be a very critical time after stocks are exhausted.

Meanwhile it is revealed in London that Russia is now the largest producer of synthetic rubber in the world.

Tyres produced there had withstood severe practical tests over thousands of miles of roadless wastes.

America will be producing synthetic rubber at the rate of 700,000 tons a year by the end of 1943.

Announcing this, the Commerce Secretary (Mr. Jesse Jones) said that the Federal Government had let contracts for the construction of synthetic rubber plants to several chemical and oil companies.

The Mexican rubber shrub guayule has been introduced into Australia as a possible means of building up a raw rubber industry.

The Council for Scientific and Industrial Research, which imported the shrub, has an experimental plot thriving in the mountains.

Some authorities believe the plant can be developed commercially to provide a partial substitute for the loss of rubber from the Pacific area.

Some time ago experiments proved that Hevea rubber plants grew remarkably well in the Tully and Innisfail districts.

Some of them attained a height of 7ft. and a girth of 3in. by the end of 12 months.

Army May Use Pigeons

CARRIER pigeons might be used for local Army communications. In the House of Representatives, Mr. Brennan (Vic.) asked the Army Minister (Mr. Forde) whether the importance of carrier pigeons had been considered.

"They are regarded as an important arm of defence on the Continent and in Great Britain," Mr. Brennan added.

Mr. Forde said: "I realise the great importance of carrier pigeons in modern warfare.

"Representations have been made to me by the Carrier Pigeon Association. I have agreed to meet them."

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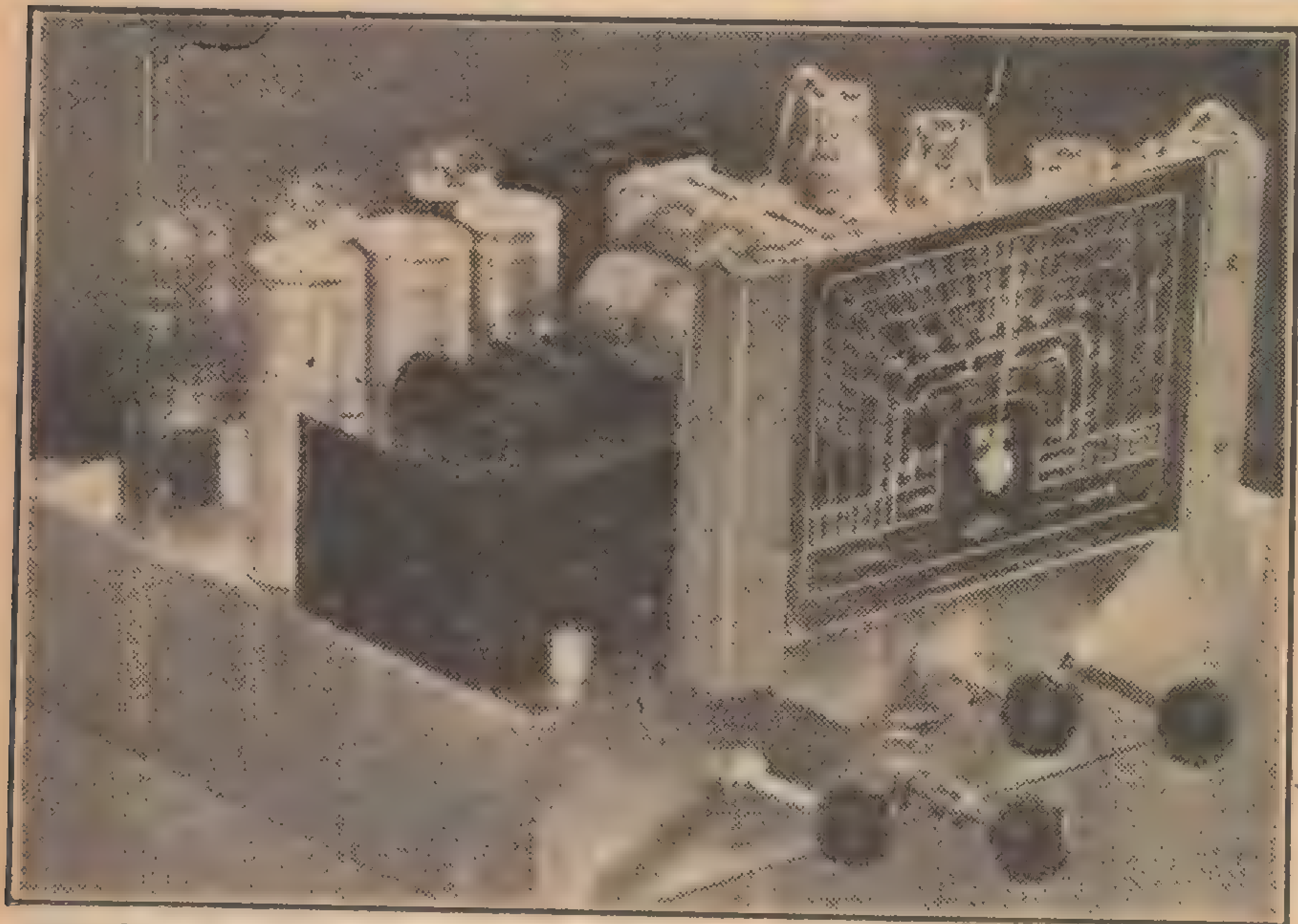
LOCAL STATIONS AT THEIR BEST
THE T.R.F.
QUALITY
SIX

PRESENTING — THE T.R.F. QUALITY SIX



A front view of the chassis. The power transformer in the original was actually a 150 milliamp type, but a 125 milliamp type transformer is quite large enough. The pickup terminals are just near the transformer. The control on the left is the tone control, that on the right the volume control. In the centre is the tuning knob and the pickup switch.

Modern superheterodyne receivers are excellent in most respects but they have the serious disadvantage that, as a result of their comparatively high selectivity, the audio frequency response above about 2000 or 3000 cycles per second is very poor. Here is a T.R.F. receiver of limited selectivity, which is capable of giving truly excellent reception of the local stations.

THE very title of this article will probably give rise to a lot of argument around the old and vexed question of T.R.F. receivers versus superheterodynes. It might save a lot of heart-burnings if we go into the matter right at the outset. The discussion might also be helpful to those who may not be able to understand what selectivity has to do with audio fidelity.

The system of broadcasting at present in use utilises the method of modulation known as amplitude modulation. With this method, the audio frequency voltages are utilised to vary the amplitude or peak voltage of the carrier, the frequency of the carrier itself remaining constant.

FREQUENCY MODULATION

In America, another method of modulation, known as frequency modulation, is being put into commercial use. Ambitious claims are made for this system, and it may be that, after the war, we shall see frequency modulated stations in operation in Australia. However, for the time being, we can afford to pass it over.

Probably all will recall having seen, at some time or other, a diagrammatic illustration of a high frequency carrier, amplitude modulated by a single audio tone. The width of the so-called "modulation envelope" varies in a periodic fashion according to the particular modulating audio frequency.

In actual practice, a broadcasting station seldom, if ever, transmits a carrier modulated by a single audio frequency. As a rule, the modulation is a very complicated audio voltage, whether the programme be speech or music. However, irrespective of this, the modulation envelope, as seen, for example, on the screen of a cathode-ray tube, remains basically the same.

It consists of the high frequency carrier which varies in width from one instant to another, according to the audio voltage being super-imposed upon it.

Simple as it may seem at first glance, the modulation envelope does not tell a complete story. According to the theory of sidebands — which seems to work out in practice — an amplitude modulated carrier cannot be regarded simply as a high frequency voltage whose amplitude varies in sympathy with the modulating voltage. It is really more complicated.

When an audio frequency voltage is super-imposed on a high frequency carrier, additional voltages are generated at frequencies equal to the sum and difference of the carrier frequency and the super-imposed audio frequencies.

Thus, if an audio frequency voltage at 1.0 Kc/s is super-imposed on a high frequency carrier at 1000 Kc/s, additional high frequency voltages, known as sidebands, are generated at 1001 Kc/s and at 999 Kc/s.

If, as is usually the case, the modulating voltage is a complicated pattern of different audio frequencies, a very large number of sidebands are generated simultaneously.

NOT SO SIMPLE!

Thus, what at first sight appears to be a simple modulation envelope containing the carrier frequency and one or more audio frequencies is really a combination of the carrier frequency and a variety of sidebands differing from the carrier frequency by an amount equal to the various modulating frequencies.

To put it another way: What a broadcasting station actually transmits and what is actually received in your aerial is a signal voltage at the nominal carrier frequency plus a motley collection of sidebands, at frequencies differing from that of the carrier by a few hundred or a few thousand cycles, as the case may be.

When these arrive at the detector, they re-combine, as it were, to form the familiar modulation envelope, from which the audio component is extracted for subsequent amplification.

SELECTIVITY

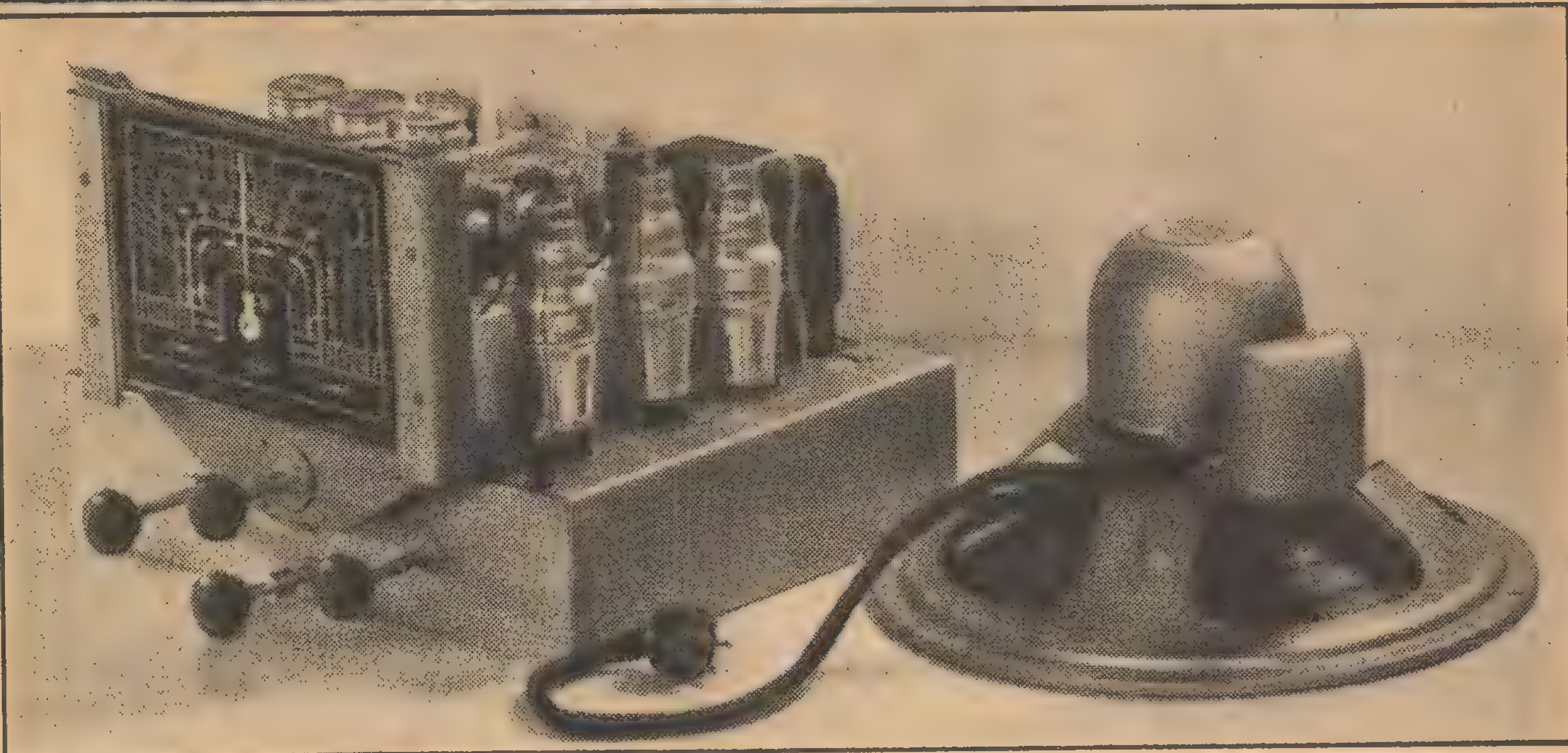
This brief explanation may not entirely satisfy those readers who prefer a strict mathematical approach to the subject, but it should convey the general idea.

It follows that, if the audio frequencies super-imposed on the carrier are to be faithfully reproduced by the receiver, the latter must be capable of receiving all the various sidebands. If, for some reason, some of the sidebands

PUBLIC ADDRESS ARTICLES

AS you see, no special Public Address article is included in this issue. We deemed it wise to break the series in deference to those readers not particularly interested in the subject. However, amplifier enthusiasts will no doubt be interested in this receiver, which is built around a slightly different version of last month's amplifier PA-3. In addition, the current series of articles on the cathode-ray oscillograph should provide quite a lot of food for thought.

BETTER RECEPTION OF LOCAL STATIONS



The completed receiver has a pleasing and business-like appearance, despite the fact that the chassis was not specially designed for it. The two r-f amplifier valves and the duo-diode-pentode are ranged along the side of the chassis. Along the back of the chassis are the power choke, the two output valves and the rectifier. The aerial and earth terminals are to the front of the chassis, near to the first r-f amplifier valve.

do not reach the detector, it is fairly clear that at least some of the audio frequencies originally super-imposed on the carrier will not appear in the output.

Here is where the matter of the selectivity comes into it. You remember that we mentioned that the sidebands differed in their frequency from that of the carrier by an amount equal to the various modulating frequencies

If a receiver is so selective that it will not pass the sidebands too widely separated from the carrier, the fidelity of reproduction must suffer. The sidebands most removed from the carrier frequency as a result of high modulating audio frequencies are those which suffer most severely.

CONSIDERATION OF FREQUENCY RESPONSE

It is generally reckoned that, for faithful reproduction of the original, the transmitting and receiving equipment should reproduce faithfully all frequencies between the limits of about 25 and 15,000 cycles per second.

However, only the very keenest would notice any deterioration if the response were limited to between 30 and 10,000 cycles per second.

Modern broadcasting stations are quite capable of transmitting this range of frequencies. In Australia, the broadcasting stations are separated by 10 Kc/s, so that the highest modulation frequency they can impose on the carrier without transgressing on one another's "territory" is 5 Kc/s, or 5000 cycles per second.

However, because of the geographical situation of the stations, it is possible to transmit a wider range of frequencies without causing much trouble Nevertheless, we all know the effect of sideband "splash" or "chatter" which is often heard on distant national stations when transmitting non-recorded programmes.

Such is the selectivity of the usual Superheterodyne receiver that the frequency response, above about 3000 c/s is very poor, indeed. The majority of listeners rather like the resultant "mellow" tone. Nevertheless, the fact remains that under these conditions, music loses much of its character; speech, although perfectly intelligible, is lacking in the sense of presence.

However, a well-designed superheterodyne receiver—note that we said well-designed—wins "hands down" as regards station to station performance, versatility, and ease of control.

Some may hold up their hands in protestation at this statement, but its truth is evident in the universal adoption of the superheterodyne principle, despite the greater complexity of the circuit.

Continued on next page.

LIST OF PARTS

1 chassis, 13 x 11 x 3.
1 power transformer, 385v CT, 385v HT at 125 mA, 6.3v at 3 amp, 5v at 3 amp.
1 power choke, 125mmA.
1 aerial coil, 2 RF coils.
1 3-gang tuning condenser, H type, with trimmers to suit.
1 tuning dial to suit.
3 8-mfd electrolytic condensers, 2-600v, 1-500v.
2 25-mfd electrolytic condensers
1 .25-mfd tubular condenser.
5 .1-mfd tubular condensers.
4 .05-mfd tubular condensers.
1 .01-mfd mica condenser.
1 .01-mfd tubular condenser.
2 .002-mfd mica condensers.
1 .0001-mfd mica condenser.
1 .0005-mfd mica condenser.
1 .00005-mfd mica condenser.
3 2-meg 1 watt resistors.
2 .1-meg 1 watt resistors.
1 .1-meg ½ watt resistor.
2 .5-meg ½ watt resistors.
1 .25-meg 1 watt resistor.
1 25,000-ohm 1 watt resistor.
1 25,000-ohm 2 watt resistor.
1 .02-meg 1 watt resistor.
1 200-ohm WW resistor.
1 250-ohm WW resistor (100 mA).
1 2000-ohm WW resistor.
1 2500-ohm WW resistor.
2 .25-meg potentiometers.
1 2-way switch.
3 trimmers (if not on gang).

SOCKETS: 1 5-pin, 6 octal.

SPEAKER: 1000 ohm field. Transformer matched to push-pull 6F6-G's, plate to plate impedance 14,000 ohms.

VALVES: 2 6U7-G, 1 6B8-G, 2 6F6-G, 1 5Y3-G.

SUNDRIES: 2 dial lamps, 4 knobs, 4 terminals, 3 goat shields, 3 small grid clips, braided wire, hook-up wire, nuts and bolts, 4 long bolts for mounting gang.

A rear view of the chassis. Note the disguise plate covering the unused valve hole. The power choke partially covers this hole and occupies the position originally intended for the second I-F transformer. If the gang condenser is not fitted with trimmers, these have to be bought separately and soldered in place. The trimmers can be seen along the side of the gang condenser.

HUMAN NATURE!

Herein lies one of the peculiarities of human nature. The majority of listeners (at least, in the City areas), having duly satisfied themselves that the receiver is capable of getting the interstate and perhaps overseas stations, promptly tune it to the local stations and restrict their listening to those.

Fortunately, perhaps, there are quite a number of people who are willing to recognise this apparent contradiction and who are quite satisfied to forfeit the potential but unused station-getting abilities of their receivers, if, in so doing, they can achieve better reproduction of the local stations.

VARIABLY SELECTIVE SUPERHETS

The ideal scheme is, undoubtedly, to provide a superheterodyne receiver with a means of varying the selectivity. Indeed, a number of commercial receivers have been released incorporating this feature.

However, to date, it is doubtful whether any scheme has been developed which makes it an easy matter for variable selectivity to be included in home-built receivers. Various circuits and components have, indeed, been put forward, but they do not seem to have taken on to any great extent.

Until a really attractive scheme is evolved, probably the best way out for the home-builder is to use a TRF circuit.

T.R.F. RECEIVERS

TRF receivers are usually less selective than superheterodynes, and the sideband cutting is consequently less severe.

Here, one must make a reservation. It does not follow that any TRF will be better than any superheterodyne receiver. For various reasons, for example, as a result of regeneration, a TRF may cause sideband cutting as serious as with a superheterodyne, even though the apparent selectivity is poorer.

Ideally, the receiver should be as inselective as conditions will allow and should always be operated in a stable condition, without regeneration, accidental or otherwise.

It follows, more or less as a matter of course, that a receiver of this type is only really suitable for operation in city areas, where one has a good choice of half a dozen or so local stations.

An inselective receiver is scarcely a proposition in remote districts, where the problem is rather to get reasonable reception without being unduly worried about the fine points of reproduction.

In any case, the occasions when a sustained high frequency response could be used to advantage would be few and far between, as a result of the low signal strength of the stations and the comparatively high noise level.

It is found, in practice, that static and man-made interference can even mar high-quality reception of stations situated in the same city area.

THE OBJECTIVE

Bearing all these facts in mind, we set out to design a TRF receiver to meet the needs of the many readers in city areas who are anxious to have better reception of local stations.

It was obviously not desirable to design a TRF receiver with the best possible selectivity, since that would have defeated our object.

The completed receiver is therefore not one capable of giving a good station-to-station performance. In fact, its performance in this respect may not be nearly as good as others designed many years ago.

We must emphasise this point lest some of our readers misunderstand our object and be disappointed that the receiver will not log as many stations as some other receiver of older vintage.

On the other hand, there is also a limit to the degree of inselectivity. The receiver will naturally be built up by readers in all kinds of localities, and we have no desire to receive bundles of letters complaining that the receiver will not separate certain local stations.

So we must strike a medium which we feel will suit the majority. If you feel that you can do with less selectivity, it is not a difficult matter to arrange.

THE RECEIVER

After this rather lengthy preamble, we can now discuss the completed receiver in detail. Taking things in order, there is, first of all, the matter of the chassis.

For reasons which we shall discuss presently, we desired to accommodate two r-f stages, a detector, two output valves and a rectifier. There were, of course, the other necessary components to be considered.

In keeping with our present policy of avoiding the introduction of new chasses, we cast about for a chassis which could be pressed into service.

The chassis which we ultimately chose was one originally intended for a 5/6 valve broadcast superheterodyne receiver.

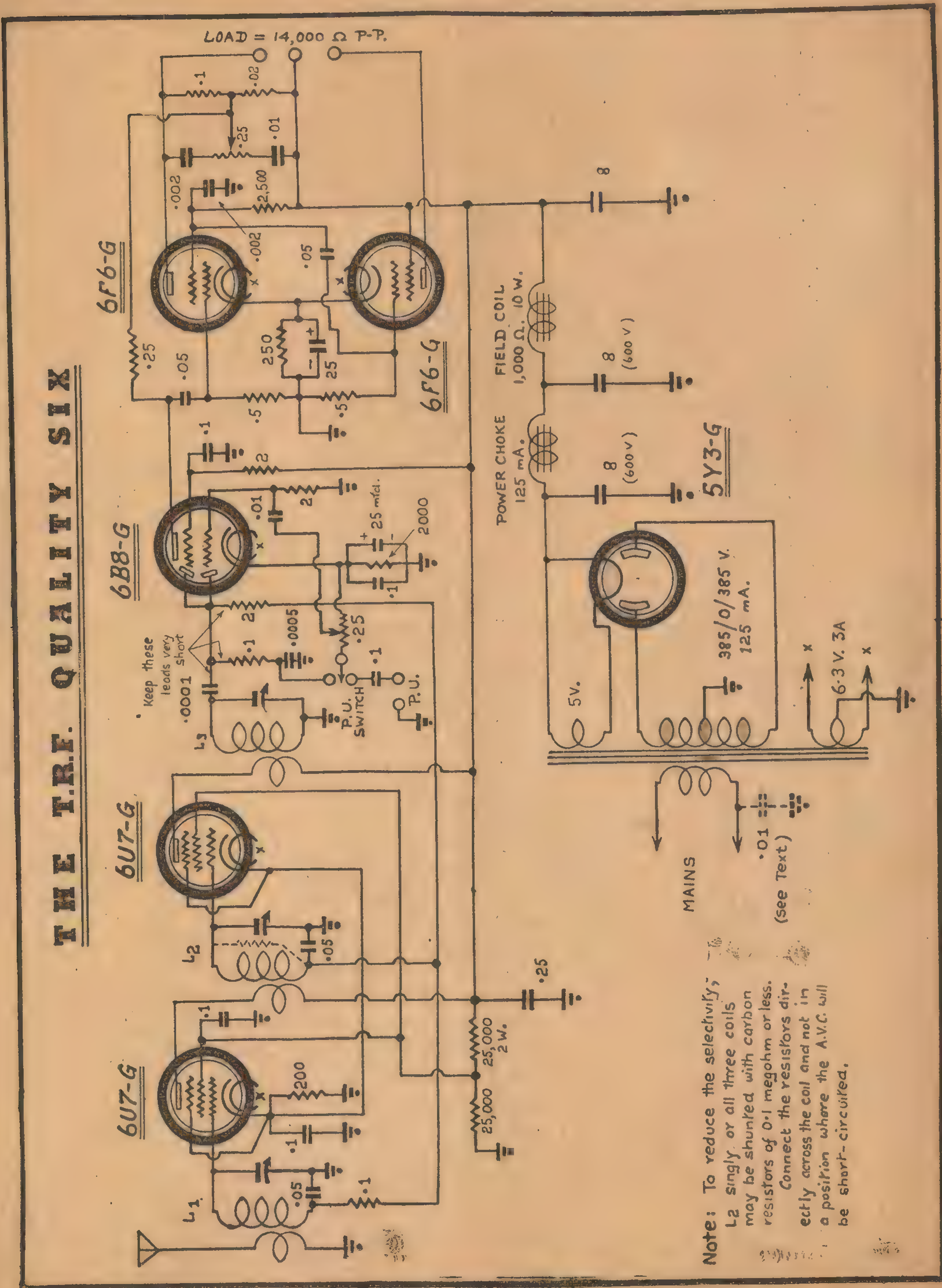
In actual fact, the chassis was the identical chassis upon which we built the SUPER SIX BROADCAST receiver, described in the September issue last year.

FITTING THINGS IN

The three coils fitted into the appropriate holes. The second r-f amplifier occupied the position intended for the converter valve.

A few minutes' work with a round file served to open out the holes, where the first I-F transformer fitted, to a single hole of diameter 1¼ inches; after drilling two small 5-32in. holes in the

COMPLETE SCHEMATIC CIRCUIT DIAGRAM



correct positions we were able to mount the socket for the diode detector.

There remained the space normally occupied by the I-F amplifier valve and the second I-F transformer. The valve hole was duly covered with a disguise plate and the vacant space occupied by mounting the power choke on top of the chassis.

The remaining holes came in nicely for the two output valves and the rectifier.

THE LAYOUT

You should not have undue difficulty in getting a chassis intended originally for the Super Six Broadcast Receiver. If you can, we suggest that you follow our layout exactly. However, almost any other chassis for the same style of receiver could probably be pressed into service

Make sure that the chassis has sufficient space to allow the coils to be mounted between the gang and the valves. Otherwise, you may have to put up with the effects of long leads or, alternatively, you may have to mount the coils underneath the chassis.

From the various photographs it is possible to get a good idea of the layout of the major components. More may be said in regard to these as we proceed with the description.

Now comes the matter of the circuit:—

You will note, first of all, that there are two stages of tuned radio frequency amplification, followed by a diode detector.

The two stages of amplification ensure that there will be ample gain for all occasions, so that you need have no worry as to the ability of the receiver to receive the necessary stations, even with a modest aerial.

We switched on the experimental receiver late one night and heard two or three overseas broadcasting stations coming through a rather heavy barrage of static. Naturally, all the local stations had closed down, and the rather poor selectivity of the receiver did not matter.

RESISTOR COLOR CODE

VALUE	BODY	END	DOT
.2 meg	Red	Black	Green
.5 meg	Green	Black	Yellow
.25 meg	Red	Green	Yellow
.1 meg	Brown	Black	Yellow
20,000 ohms	Red	Black	Orange
25,000 ohms	Red	Green	Orange
2,000 ohms	Red	Black	Red

SELECTIVITY

The fact that a diode detector is used has an important bearing on the matter of selectivity in that it loads the associated tuned circuit and reduces the selectivity.

An anode-bend detector, on the other hand, does not load the tuned circuit. A reflex detector may actually have a negative input resistance and would have the effect of increasing the tendency towards instability, of increasing the selectivity and therefore of limiting the high frequency response.

Thus, the overall selectivity of the receiver as it stands may not be very much higher than that of a receiver using but a single r-f stage and a reflex detector.

However, if you consider that you can do with still poorer selectivity, it is not a difficult matter to reduce it by loading the tuned circuits, as suggested on page 30.

R-F. AMPLIFIERS

The r-f amplifying valves operate under ordinary conditions. The plate voltage is just under 280 volts, which is quite safe for these valves.

The two screens are tied together and supplied through a divider network comprising two 25,000 ohm resistors. This provides just about the necessary 100 volts under typical signal conditions. Note that the resistor between the screens and B plus must be rated at least at two watts.

The grids ultimately return, through the AVC network, to the cathode of the 6B8-G valve. This is at a potential of about one volt positive with respect to earth, so that this potential is applied to the grids under no-signal conditions.

The cathode bias resistor must therefore be arranged to provide a potential of about 4.0 volts, cathode to earth. The value works out to be near enough to 2000 ohms.

The coils used in the experimental receiver were of the litz-wound air-cored variety, with high impedance primary windings. These are quite suitable, although the old style solenoids could be used if they are on hand.

Iron-cored coils are another possibility. Time did not permit us to try them out, but it seems likely that the selectivity would be unnecessarily high and there may also be a greater tendency to instability.

INSTABILITY

As with all TRF receivers, particular care has to be taken to guard against instability.

The first three valves should be shielded, the shield being grounded properly to the chassis. The leads to the grids should be kept as short as possible and not too close together.

In the experimental receiver, we made the connection from the fixed plates of the gang condenser to the coils, underneath the chassis. The leads to the grid caps of the valves were taken out the top of the coil cans, straight up to the grids.

The plate leads should also be made short and as direct as possible. The wipers on the rotor plates of the gang should be individually connected to the earth point for the associated valve.

OTHER POINTS

Likewise, the bypass condensers for the various portions of the circuit should be kept as close as possible to the points to be bypassed. The return should preferably be made to an earth point associated with the particular valve.

The common screen circuit and the common cathode circuit for the two r-f stages is a possible source of feedback, but separate circuits did not appear to be warranted in the experimental model. If trouble is experienced with instability, it may be worth while to try the effect of using separate circuits. However, remember that the values of the resistors will need to be suitably modified.

All these points are, in themselves, only of minor import. However, they are the points which have to be taken into account in the event of the receiver proving unstable.

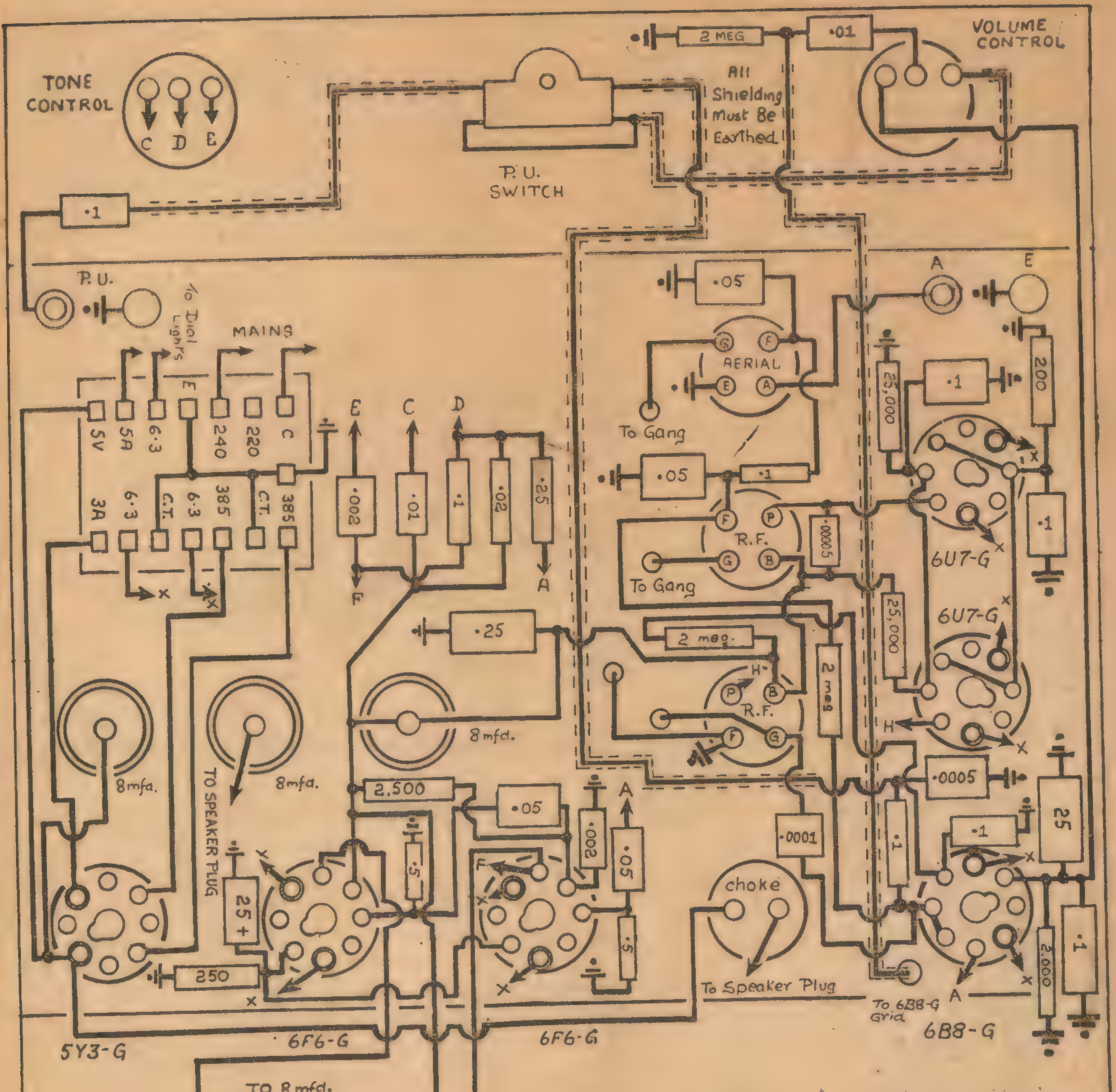
INSTABILITY AT LOW FREQUENCIES

With coils having high impedance primaries, a peculiar form of instability may be encountered at the low frequency end of the band.

The high impedance primaries are wound so that they resonate with distributed and circuit capacitances at a frequency just below the low frequency end of the band. The purpose of this is to sustain the gain of the coils at frequencies, where it would otherwise tend to fall off rather badly.

Most enthusiasts will remember that the old-style TRF receivers with ordinary coils were always much more sensitive at the high frequency end of the band.

UNDERNEATH WIRING DIAGRAM



The underneath wiring is fairly complicated but, with the aid of this diagram and the schematic circuit on page 25, you should be able to get things right. The group of resistors in the centre of the chassis are mounted on a panel, although the outlines of the panel have been omitted for the sake of clarity.

With high impedance primary windings, the characteristics of the coils at the low frequency end of the band approach those of a double tuned transformer. The gain may be increased to such an extent that actual instability results.

The connection of the aerial to the aerial terminal may stabilise the receiver because the aerial loads the circuit and the added capacitance shifts the resonant frequency of the primary circuit to a frequency well beyond the low frequency end of the band.

In the experimental model, we actually experienced some difficulty in this regard, the receiver being very unstable with no aerial connected. Even with the aerial connected, the trouble was still apparent at the extreme low frequency end of the band.

An improvement was effected by adding a .00005 mfd bypass condenser in parallel with the primary of the second r-f coil. A large condenser or, alternatively, a similar condenser across the primary of the third coil made the receiver stable, even without an aerial connected, but the gain at the high frequency end of the band suffered considerably.

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It is often found that trouble with instability at the low frequency end of the band will disappear if the receiver has both an aerial and an earth connected. This is usually no great hardship, if the receiver is to be located in a permanent position.

If there is any difficulty in providing an earth connection, the desired result may often be achieved by bypassing the chassis to one side of the mains through a .01 mfd condenser.

Note, however, that the condenser should be a good mica type. Try each side of the mains in turn or reverse the plug in the socket, choosing the best connection. The chassis may give you a tingling sensation when touched, but there is scarcely any danger of shock if the condenser is a good one.

Of course, you may not have any trouble along these lines, but the foregoing remarks will prove helpful if you do happen to strike it.

A.V.C. INCLUDED

AVC was considered a desirable feature since it prevents blasting and eliminates the necessity for grabbing frantically at the volume control each time one tunes to a strong station. Of course, AVC emphasises the lack of selectivity, but this is not an important point to those who are concerned only with the question of quality.

Naturally, this decision meant that a diode detector had to be used. Actually, it is possible to arrange AVC on a receiver without having to use a diode detector, but the schemes are not by any means simple and convenient.

However, in trying to incorporate a diode detector in a TRF receiver, one runs up against difficulties. In case of a superheterodyne, the same difficulties are not met.

In a superheterodyne, the signal is fed to the diode from one side of the tuned secondary of the second IF transformer. The diode load, suitably bypassed, is connected between the opposite end of the secondary winding and the cathode of the valve. The whole of the tuned circuit, including the trimmer, is quite independent of earth.

DIODE DETECTORS AND T.R.F. RECEIVERS

In the case of a TRF receiver, this can scarcely be the case. All modern gang condensers are so constructed that the rotor plates are electrically connected to the frame of the condenser, which can hardly be at anything else than earth potential.

It is therefore not practicable to connect the diode load between the lower end of the tuned circuit and the cathode, as we do in a superheterodyne receiver.

The coil can be isolated from earth as far as d-c is concerned, but the condenser used must be at least about .05 mfd if the tracking of the tuned circuit is not to be upset. A condenser of this size has so low a reactance at audio frequencies that it is impracticable to develop any useful audio voltage

(Continued on Next Page)

across it between the bottom of the coil and the cathode.

The diode load can scarcely be connected in the live side of the tuned circuit, because the capacitances to earth would be troublesome. It would not be possible to shield any of the associated wiring.

One scheme, which seems to work out quite well in practice, is to feed the diode plate direct from the tuned circuit, connecting the load between the cathode of the diode rectifier and earth. AVC can be obtained from another diode connected in a different fashion.

VARIOUS SCHEMES

Had the double-diode type 6H6 been plentiful in Australia, it would have been a simple matter to utilise this arrangement. However, such is not the case, and we must find, if possible, a circuit which utilises an ordinary duo-diode-amplifier valve of the type commonly used in superheterodyne receivers.

One arrangement, which has been used on occasion, is to eliminate altogether the tuned circuit feeding the diode, using instead an untuned coupling transformer. The obvious disadvantage of the scheme is that it requires a special component.

Rightly or wrongly, readers do not like circuits which require special components.

After drawing out a lot of circuits and trying various schemes in the receiver, we finally evolved one that appeared to meet all the requirements.

THE MATTER OF SELECTIVITY

THE selectivity of this receiver, although purposely not of a high order, will be found to be sufficient to allow the local stations in most City areas to be separated without difficulty. In many districts, the selectivity need not be as high as it actually is.

In such cases, the selectivity may be reduced still further to good effect. The desired result may be achieved by shunting a resistor of 0.1 megohm or less across one or both of the tuned r-f circuits. The lower the value of the resistor, the greater will be the effect upon the selectivity.

One obvious scheme, which some of our readers may care to try is to arrange a rotary switch so that various resistors may be shunted at will across one or both of the tuned circuits in question. This would constitute a form of variable selectivity.

Have a look at the detector and AVC arrangement in the complete circuit diagram.

The diode detector is fed through a small condenser from the "hot" side of the ordinary tuned circuit, the other side of the tuned circuit being earthed.

The diode load, between the diode plate and the cathode, consists of a 0.1 megohm fixed resistor in series with a 0.25 volume control, the junction of the two being bypassed by a .0005 mfd condenser.

The reactance of the latter condenser at radio frequencies is very low, and the junction of the two resistors can be considered to be at earth potential for these frequencies. Therefore, the tuned circuit is loaded directly by a fixed load of 0.1 megohm, in parallel with which is the impedance of the diode itself and the 2.0 megohm AVC feed resistor.

As we explained earlier, the loss of selectivity as a result of this loading, really helps us in the expressed desire to avoid too great selectivity.

As a matter of fact, if the selectivity is still higher than the circumstances warrant, it is quite in order to load the other tuned circuits in the same manner with fixed resistors of 0.1 megohm or less.

CIRCUIT CONSTANTS

The audio voltages are developed across the network comprising the 0.1 meg and the 0.25 meg resistors. The rather low value of volume control was chosen so as to permit a .0005 mfd bypass condenser to be used without causing undue high frequency attenuation.

If you have any difficulty in obtaining a 0.25 meg volume control, use a 0.5 meg control, shunting it with a 0.5 meg fixed resistor to reduce the effective resistance to 0.25 megohm.

The two diode plates are connected together at the socket.

The output to the grid of the audio amplifier is taken from the moving arm of the volume control in the usual manner. The AVC voltage is taken from the diode plates through 2.0 megohm resistor.

As a result of the high value of the AVC feed resistor, and the method of connecting the volume control, the shunt loading on the d-c diode load is very light. This is a most important point to watch if the receiver is to handle deeply modulated signals without distortion.

In wiring this detector it is necessary to take precautions to avoid introducing too much stray capacitance in parallel with the tuned circuit.

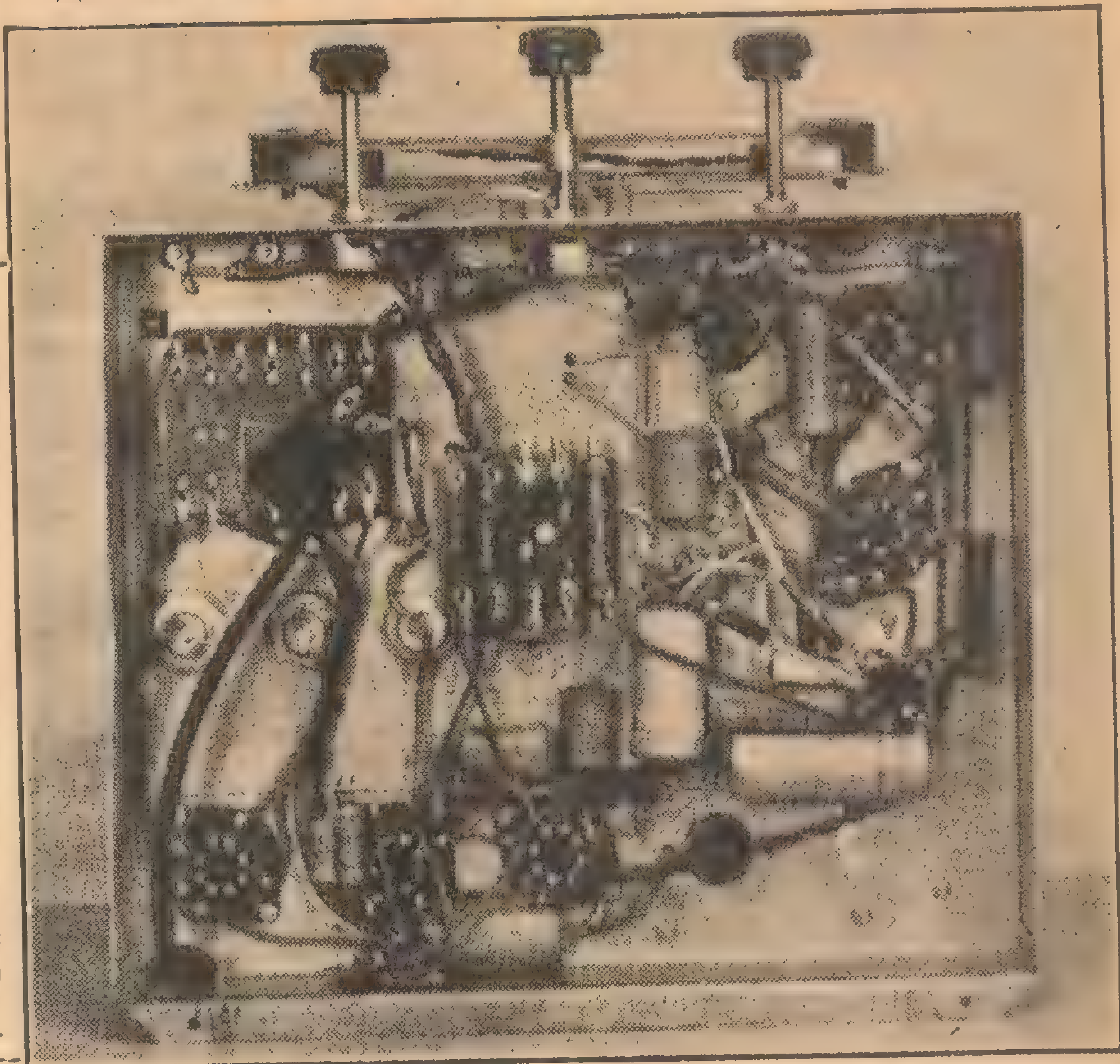
The .0005 mfd condenser must be mounted handy to the diode detector, the 0.1 meg resistor bridging the two. If either of the leads have to be extended, extend the one between the 0.1 meg and the .0005 mfd condenser.

The same is true of the 2.0 meg feed resistor to the AVC line. The resistor should be mounted right near the diode detector, extending the other lead, if necessary.

If these precautions are not taken, it will be found that the trimmer will not peak as a result of too high stray capacitance to earth.

A single-pole double-throw switch is used to change from radio to pickup amplification.

★ UNDERNEATH VIEW OF CHASSIS ★



Here is the underneath photograph of the chassis. The layout allows all the important leads to be kept quite short. Note the condenser bypassing one side of the mains to the chassis. The purpose of this condenser is stated in the article. Note also that the 250 bias resistor for the output valves was actually two smaller 500 ohm resistors in parallel. In these days when components are rather scarce, one sometimes has to resort to the use of series or parallel resistors to obtain the desired value.

PUSH-PULL OUTPUT

Since the receiver was to be described as a quality receiver, it seemed only natural to provide a push-pull audio system. And what better system could we desire than that which formed the basis of the amplifier described in last month's issue?

The immediate advantages are the economy in valves and the versatile tone control system, which can so easily be included. The actual quality of reproduction is excellent, and is of the same order as would be obtained from triode output valves.

This time, however, the output valves chosen were type 6F6-G. The chief reason for the choice was that they are rather more plentiful at the moment than type 6V6-G.

Furthermore, there are equivalents of the 6F6-G in other ranges, which should be helpful to readers desiring to use valves already on hand.

AMPLE POWER

There is very little to choose between the two types as regards power output in class A operation. We venture to say that, if you have an efficient speaker, you won't turn the receiver full up unless you are partially deaf and have a very large listening room.

You will note that the value of screen load resistor specified is 2500 ohms as compared with 1500 ohms for the 6V6-G amplifier. As we explained last month, the value of the resistor must be chosen to suit each particular type of valve and the particular operating conditions.

You will note that the resistor is shown bypassed with a .002 mfd condenser. This was included to prevent parasitic oscillation which we found could be induced under very artificial conditions. These conditions are not likely to be met in practice, but it was deemed advisable to play absolutely safe for the sake of a few pence.

VOLTAGE AND CURRENT MEASUREMENTS

HERE are the important voltage and current readings, taken while the receiver was tuned to a typical station:

Total high tension voltage ..	289 volts
6F6-G cathode bias voltage	19 volts
6F6-G screen to cathode ..	270 volts
6F6-G plate to cathode	261 volts
R-F amplifier screens	110 volts
Total high tension current ..	100 mA.

In practice, we found the tone control system to be very useful. However, more will be said of this anon.

The power supply circuit is quite conventional and scarcely needs special comment. Sufficient to say that the hum level is very low indeed. In the experimental model the hum could not be heard with the ear right alongside the cone of the speaker.

Many would be quite satisfied with the hum level as it is without the choke in place at all.

The valves specified are all modern octal types, and these will normally be used if the receiver is being constructed from all new parts. However, there are a variety of substitutes, which can be used without change to the circuit. The sockets and heater voltage may, of course, have to be changed.

ALTERNATIVE VALVES

In place of the type 6U7-G valves, types 6D6 or 78 may be used. The 2.5 volt type 58 is another possibility. For the 6B8-G, possible substitutes are the 6B8, 6B7, or the 2B7. Types 6B7S or 6G8-G are not recommended on account of their variable-mu characteristics.

For the 6F6-G valves, possible substitutes are the 6F6 metal, 42, 2A5 or even the old 47. The value of screen load resistor should not be too far out for the latter.

For the 5Y3-G, the only substitute is the 80. There are a variety of other rectifier types, but most of these would give a higher output voltage.

The speaker used with the original receiver was a 12-inch type having a cone giving a more or less linear response to at least 6000 c-s and without pronounced peaks in the region of 3000 c-s.

The receiver is worthy of a good speaker and the increased treble response will only be apparent if the speaker system is capable of reproducing the higher frequencies.

(Continued on Page 51)

Do you know?—

ABOUT ELECTRIC MOTORS

Introducing the subject of electric motors, Mr. Graham last month discussed the fundamental electrical theory, upon which a study of electric motors must necessarily be based. This month he introduces the subject of magnetism and then proceeds to discuss shunt wound motors.

Mr. L. B. GRAHAM
Principal of the A.R. COLLEGE.

MAGNETISM

WHEN an electric current flows through a wire or any conductor, it possesses the property of forming a magnetic effect, or magnetic lines of force around the wire. Current flowing through a single piece of wire does not produce a very strong magnetic field, but, if the wire is wound in the form of a coil, the magnetic effect produced by only a small current can be made strong.

By placing a quantity of soft iron or steel inside the coil, the magnetic field is concentrated, and becomes much stronger still, due to the fact that magnetic lines of force are formed in iron or steel to a much greater extent than they are in air, so that a much stronger field results. The lines of force around the wire or coil carrying electric current give it the properties of a magnet, so that it will attract pieces of iron or steel.

TWO POLES

All magnets have two points at which their magnetic influence is strongest. These points are known as poles, one being called a north pole and the other a south pole. A curious property of magnets is that if the north pole of one magnet is placed near the south pole of another, the two will be very strongly attracted together, while if the north pole of one magnet is placed near the north pole of a second magnet, the two will repel one another and push apart.

This also applies if two south poles are brought together. These facts are very definitely stated in two of the very important rules applying to magnetism; one is, that two similar magnetic poles repel one another, regardless of whether they are both north poles or both south poles; the other rule is that two unlike poles, that is, a south pole and a north pole, attract one another.

SHUNT WOUND MOTORS

HAVING now a knowledge of some of the important characteristics of electricity and magnetism, it should be easy to understand the operation of a simple type of electric motor.

The shunt wound motor consists of two separate magnets, one fixed in position and known as the field magnet, and the other mounted on a shaft which is free to rotate and known as the armature.

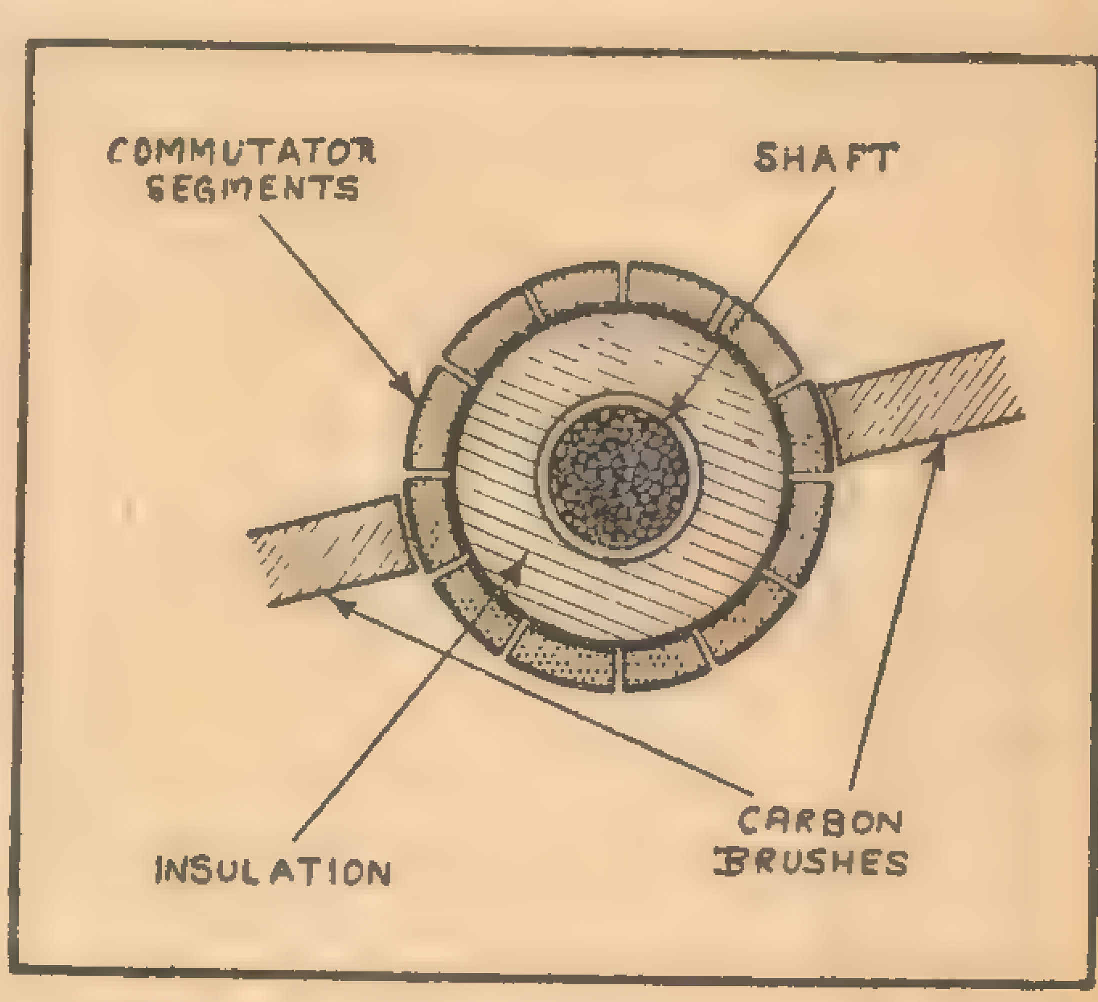


Figure 2. A section view of the commutator of an electric motor. A number of copper segments, insulated from each other, rotate with the shaft. A pair of stationary copper brushes, riding on the outer surface of the commutator segments, contact the appropriate segments at any instant and direct the current flow through the necessary windings on the armature.

The field coils are wound around two or four pole pieces or projections on an iron frame, shaped as shown in the accompanying diagram. In small motors of less than one horsepower, two poles are generally employed.

In the case of a two-pole field machine, the field magnet winding is divided into two sections, one being wound around each of the pole pieces. One end of each of the windings is joined together and the other ends are connected to the power mains.

Current from the mains flows through one winding and then through the other winding in such a direction that it forms magnetic lines of force across the gap between the pole pieces and makes one pole a north pole and the other a south pole.

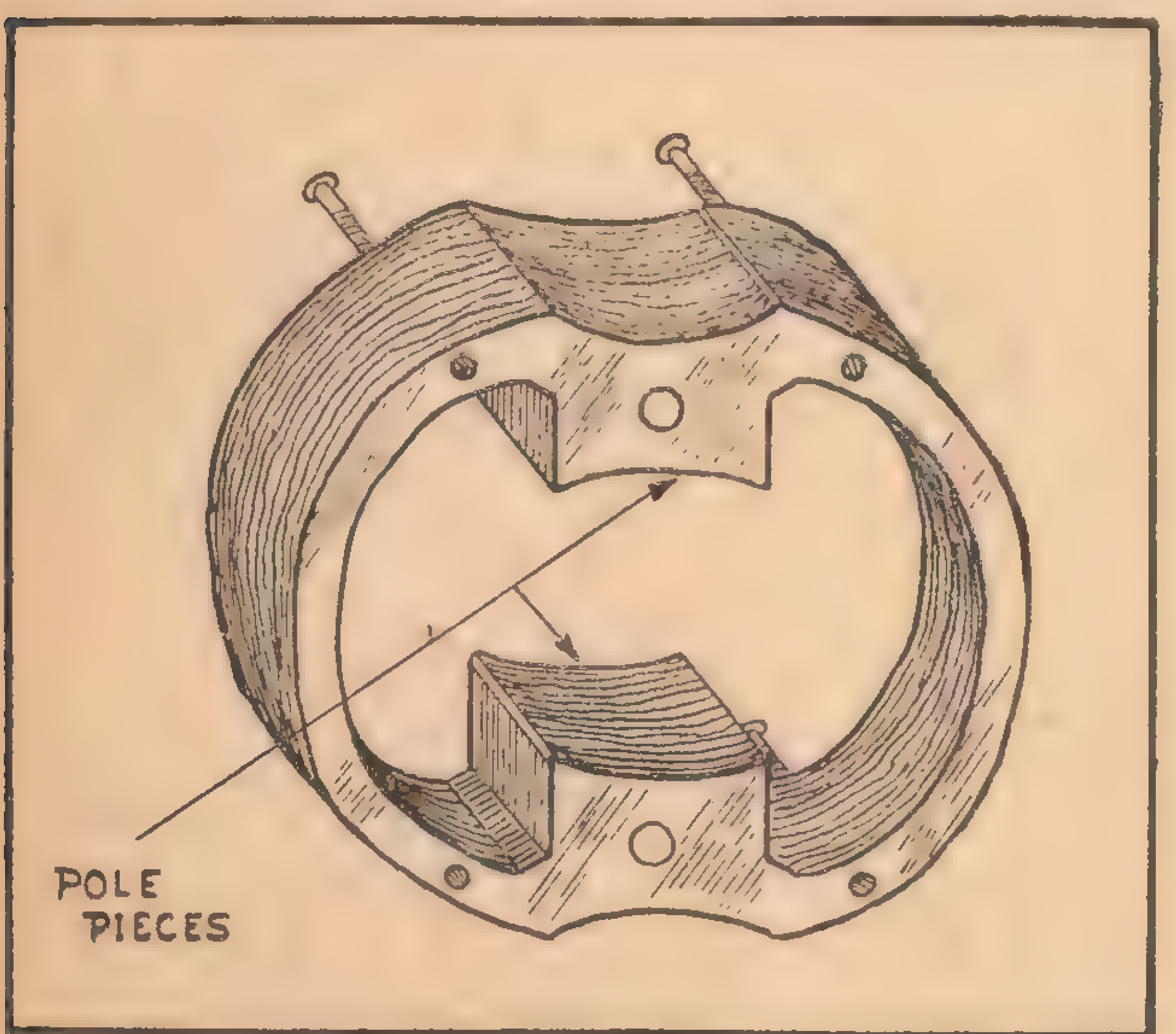


Figure 1. The iron core of a typical field magnet for a small electric motor. It is made up of a large number of iron laminations, bolted or riveted together in the same way as the core of a transformer. Laminations are used in preference to solid construction in order to avoid eddy current effects, particularly in motors to be used with an A-C supply. The field coils are wound around the two arms protruding inwards.

THE ARMATURE

The armature is made up of a number of coils of wire, wound in slots on a cylindrical iron core. The ends of the coils are connected to a commutator consisting of a number of pieces of

copper, insulated from each other by mica, and mounted cylindrically around the shaft.

Have a look at the diagram of a typical armature; the commutator can be seen at the left of the armature.

Connection is made to the armature by means of two rectangular-shaped carbon rods, known as "brushes." These are shaped to fit closely against the commutator surface, one on each side.

Small springs press the brushes firmly against the surface of the commutator and connections are made from the brushes to the power mains.

Current from the mains flows from one of the brushes to the particular section of the commutator against which the brush is pressed. It divides at this point and one portion of the current flows around the coils on one side of the armature back to a point on the opposite side of the commutator; the remainder of the current flows around through the windings on the other half of the armature to the same point on the commutator to which the other portion of the current flowed.

MAGNETIC FIELDS

At this point the second carbon brush presses against the commutator and the current flows through this back to the other terminal of the mains. The accompanying diagram indicates how armature coils are connected to the commutator sections, and the direction of current flow.

Current in flowing through the two halves of the armature in opposite directions produces magnetic lines of force around the armature, so that one magnetic pole is at the top near the brush marked plus, while the other magnetic pole is at the bottom near the brush marked minus in the diagram.

Figure 4 represents a sectional view through a small motor.

You can see that the armature is located in the most dense portion of

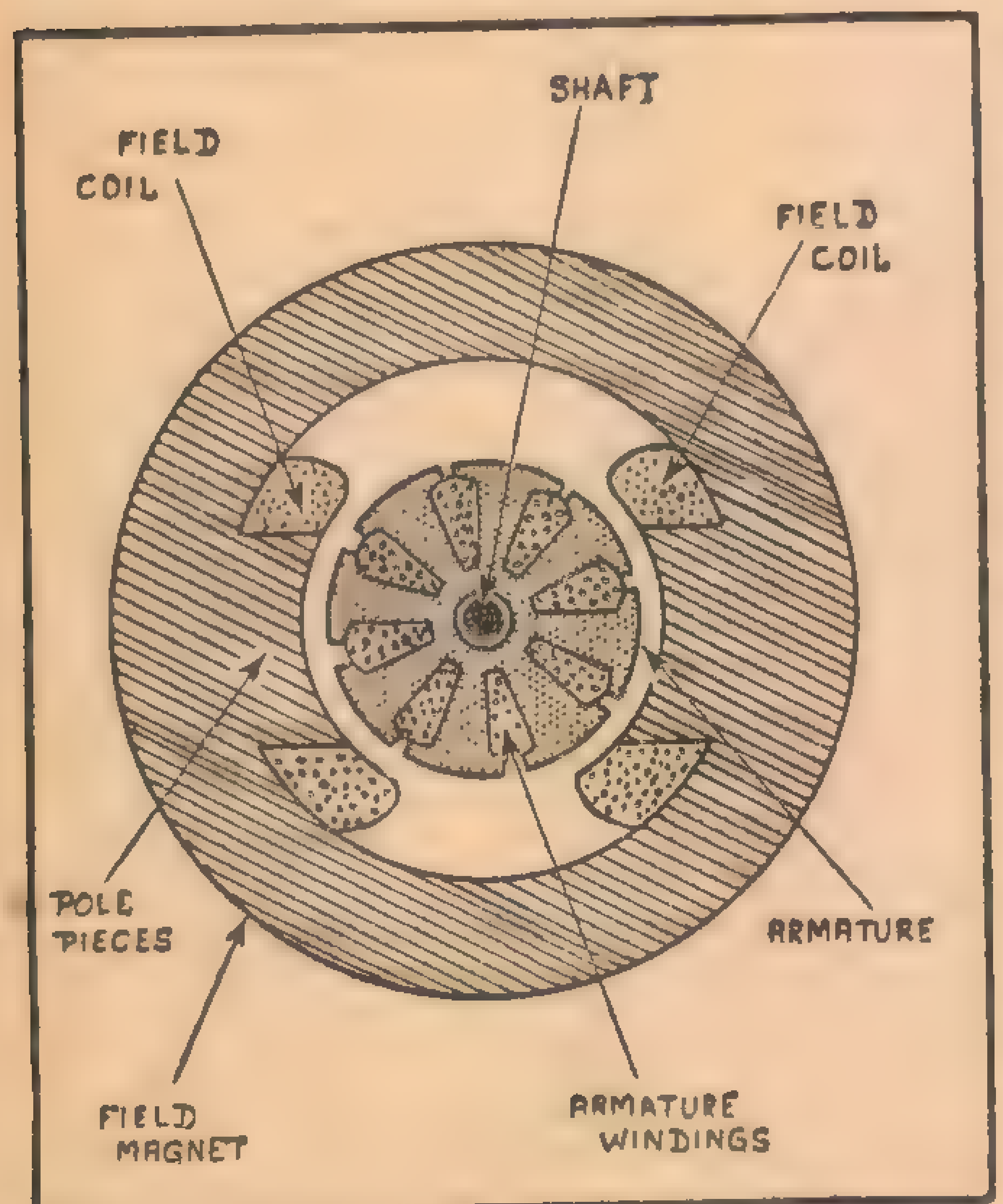


Figure 4. A cross-section sketch of a small motor. Note how the armature is located within the region where the magnetic field winding is most intense. In practice the clearance between the armature and field magnet is made quite small.

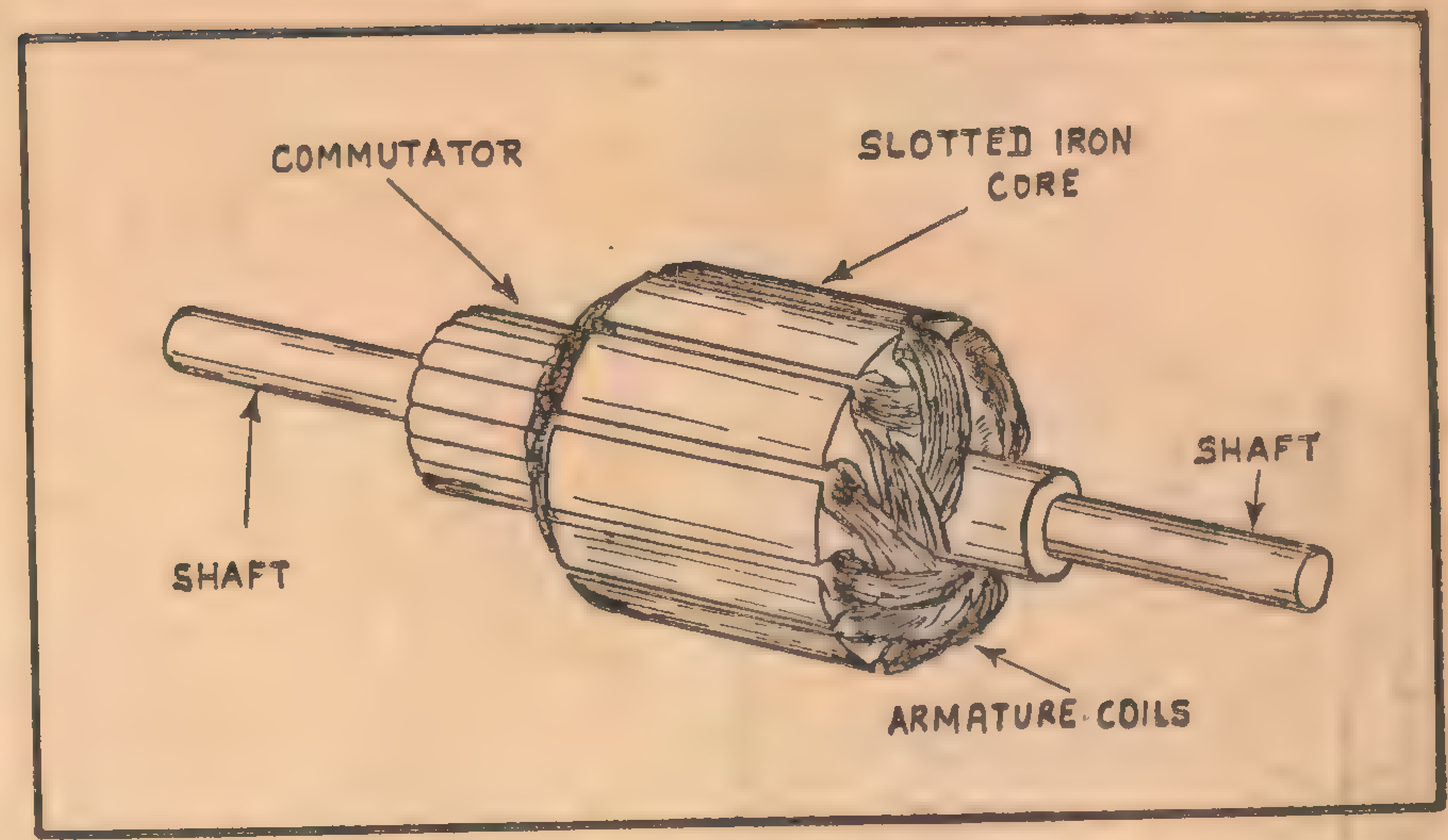


Figure 3. A sketch showing a typical armature for a small motor. The slotted core is not solid but is made up of a large number of iron laminations. This avoids heating and losses as a result of eddy currents. The winding is wound through the slots in the iron core. The commutator is mounted on same shaft at one end of the armature.

the magnetic field produced by the field coils. The lines of force produced by the field must pass through or around the armature in between the two pole pieces

TENDENCY TO ROTATE

The magnetic lines of force produced by current flowing through the armature coils will not cut or cross lines of force produced by the field magnet, consequently the turns of wire on the left side of the armature tend to move at right angles to the lines of force between the pole pieces, so that the lines of force will not be deflected from their normal path.

Similarly, the turns of wire on the right side of the armature tend to move across the face of the pole piece so that the two sets of lines of force will not interact with or deflect one another.

The armature coils are wound and connected to the commutator in such a manner that current flows downwards through the wires on the left side of the armature and upwards through the wires on the right side. All the wires in which the current flows downwards will tend to move across the lines of force produced by the field coils in one direction. We will assume that they tend to move upwards in Fig. 5.

ARMATURE SPINS

The turns of wire on the right side are carrying current in the opposite direction or upwards, so that they tend to move across the magnetic field produced by the field coils in the opposite or downward direction. The result of the interaction of these two magnetic fields is that the armature spins around in a clockwise direction.

If it is desired to change the direction in which the armature rotates, the connections either to the brushes or to the field coils can be reversed. Reversing either of these connections will reverse the direction of current flow either through the armature or field coils, as the case may be, and, of course, the direction of the magnetic lines of force will be reversed also.

As long as the lines of force produced by either the field coils or the armature are reversed, the armature will revolve in the opposite direction. If the connections to both field coils and armature are reversed, the armature will continue to rotate in its original direction.

The commutator, of course, revolves with the armature and directs the flow of current flow from the carbon brushes so that it always flows through the appropriate turns on one side of the armature in one direction and through the appropriate turns on the other side in the opposite direction.

ELECTRICAL CONNECTIONS

The disadvantage of shunt wound motors is that they are not capable of starting off under a heavy load. If a shunt wound motor is switched on when connected to a heavy load, it would not possess sufficient starting power or starting torque to revolve and the large amount of current flowing when a motor is started would burn out the windings.

(Continued on Page 49)

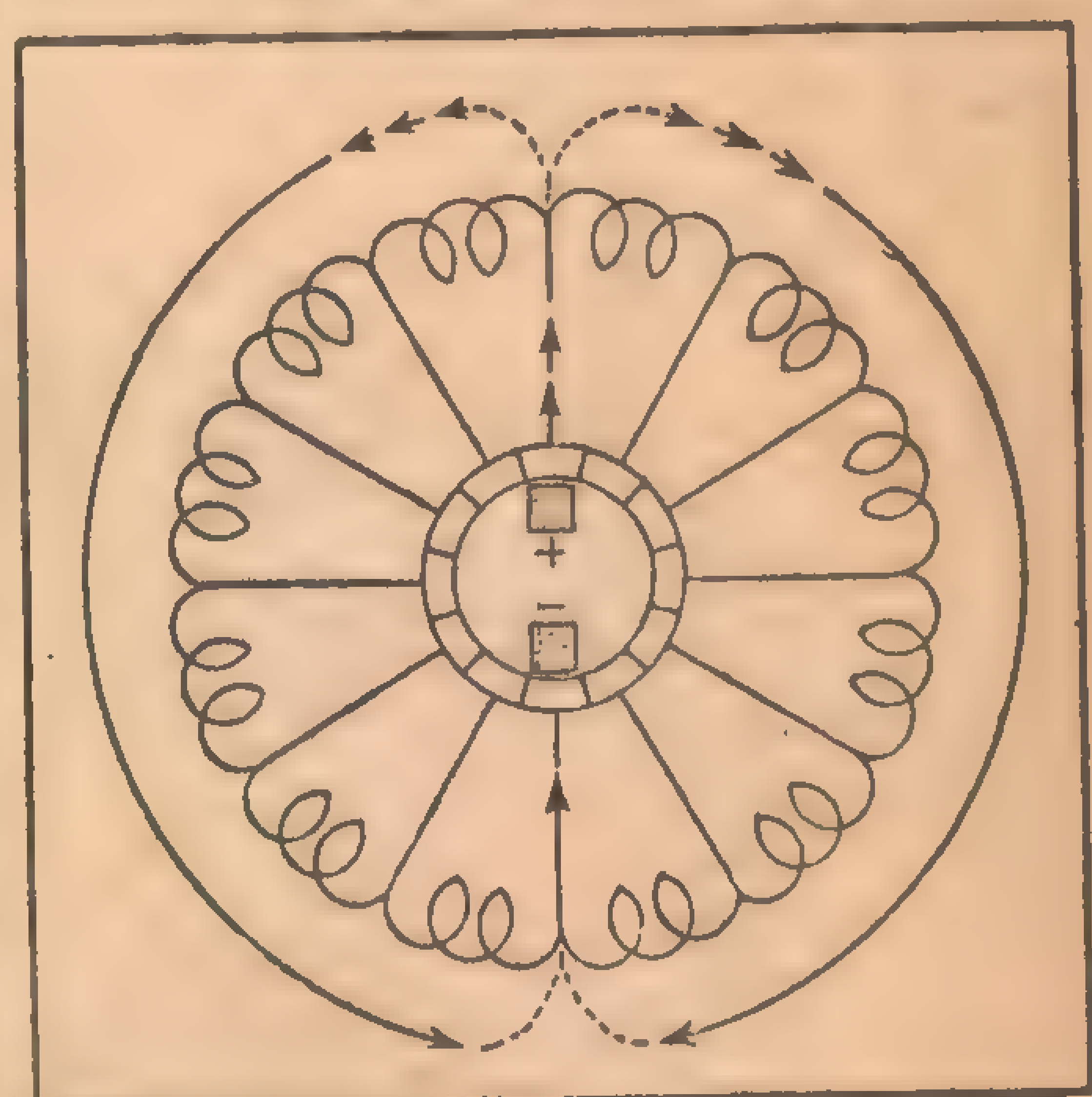


Figure 5. When the supply potential is applied between the brushes in a shunt wound motor, the current divides, half flowing through one side of the armature windings and half through the other.

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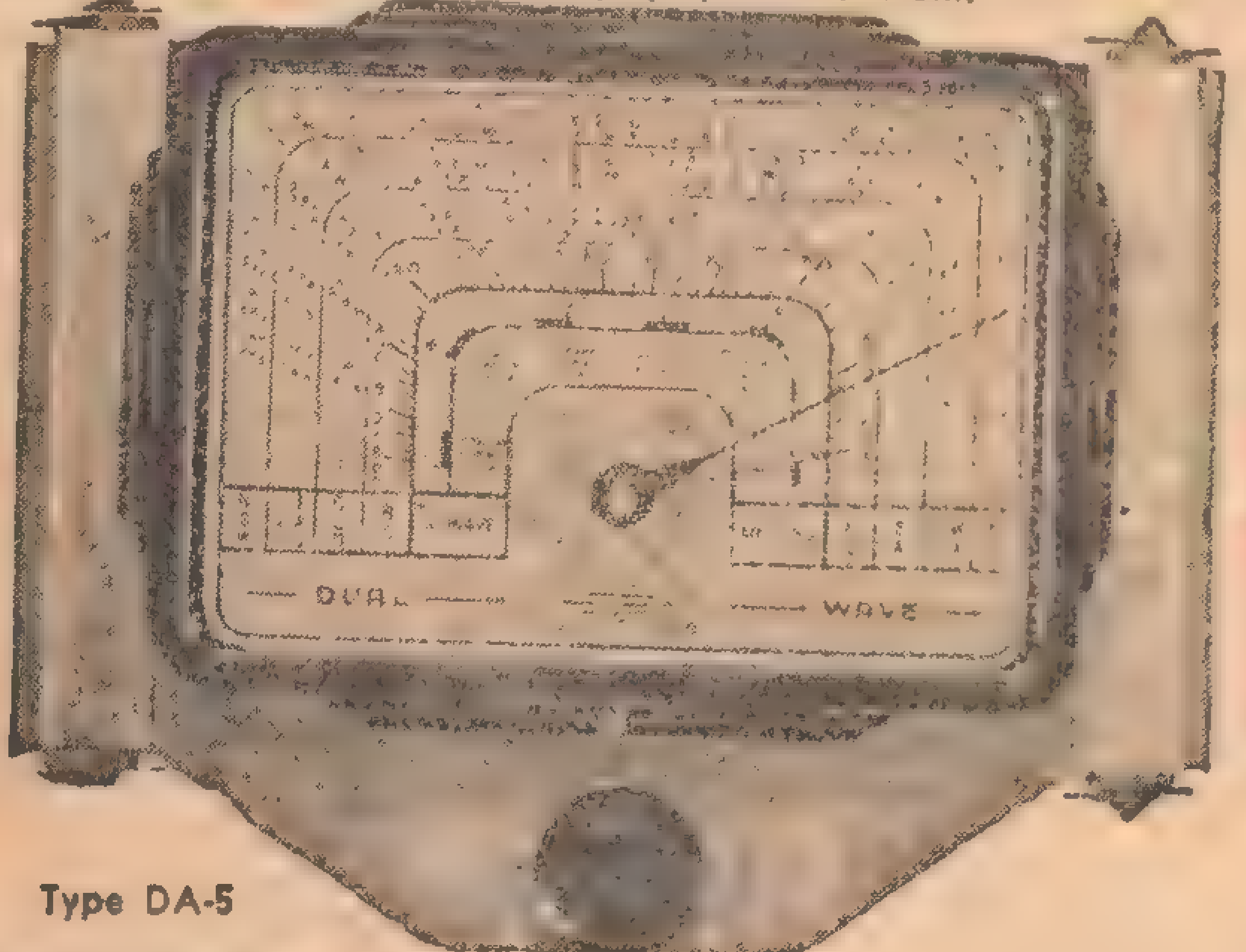

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DA-2 Communications Dial	22/6
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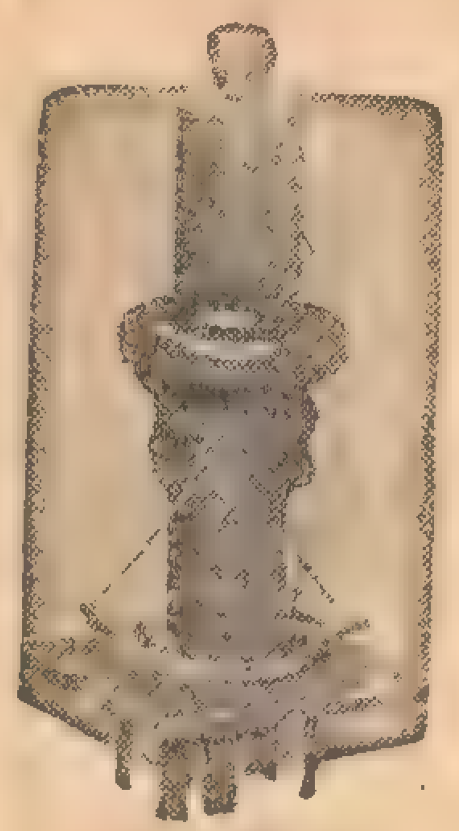

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E343 R.F.	6/6	E346 R.F.	8/6
E344 Osc.	6/6	E347 Osc.	8/6

T.R.F. TYPE "H" GANG AIR CORE

T88 Aerial	6/6
T89 R.F.	6/6
T87 R.F. with reaction	6/6

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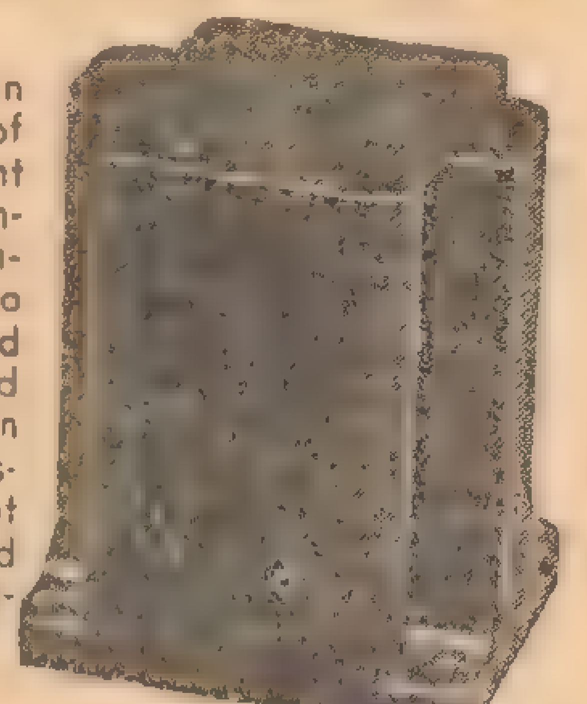

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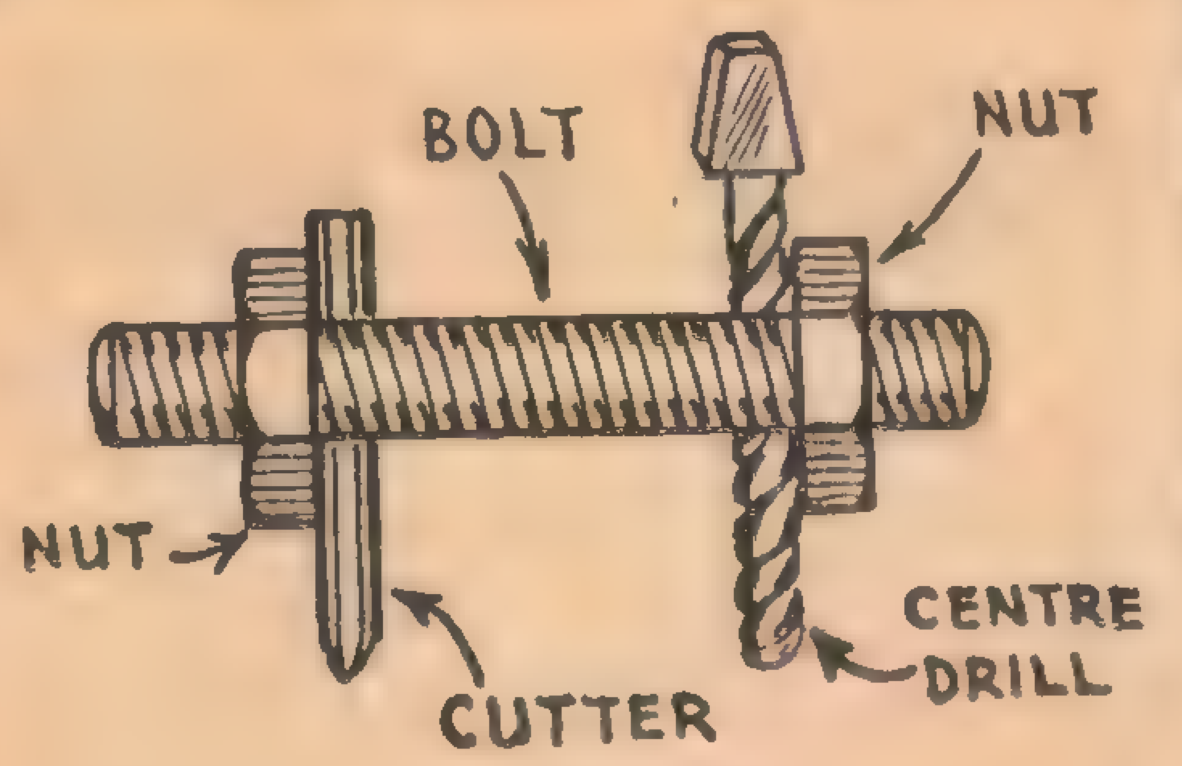
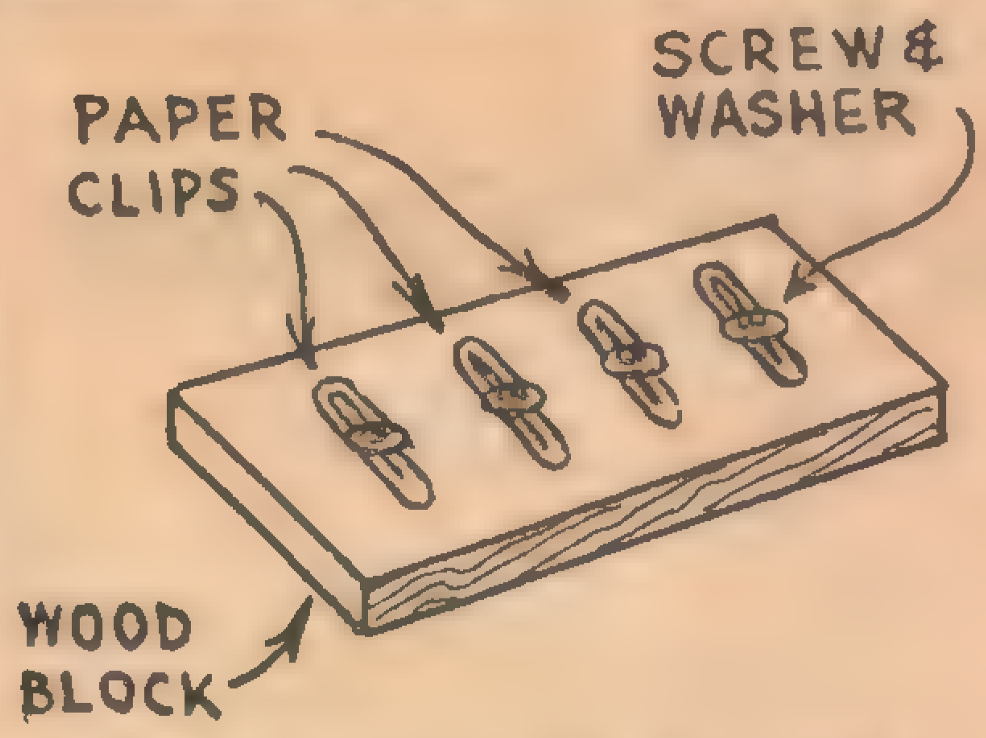


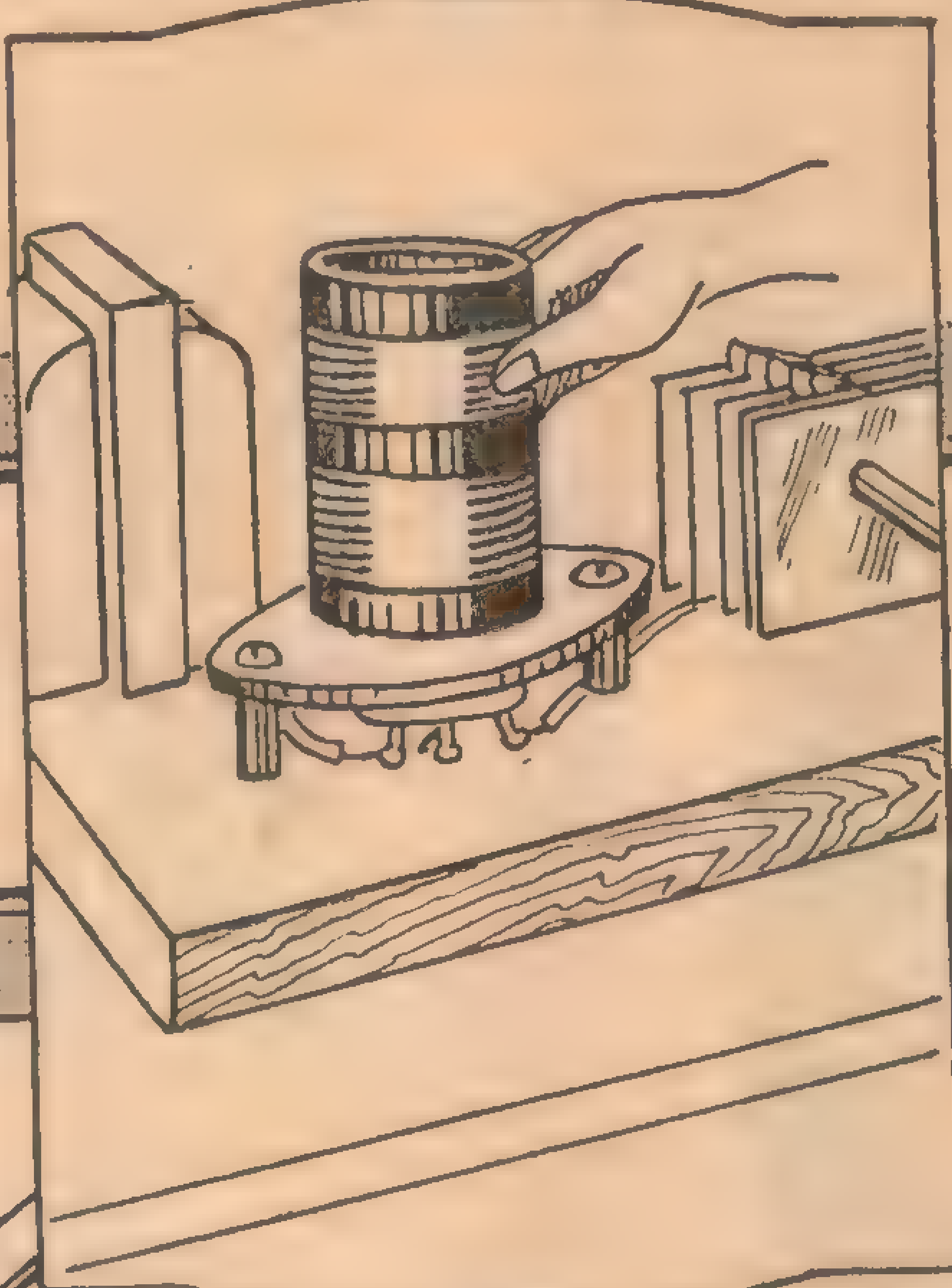
CIRCLE CUTTER

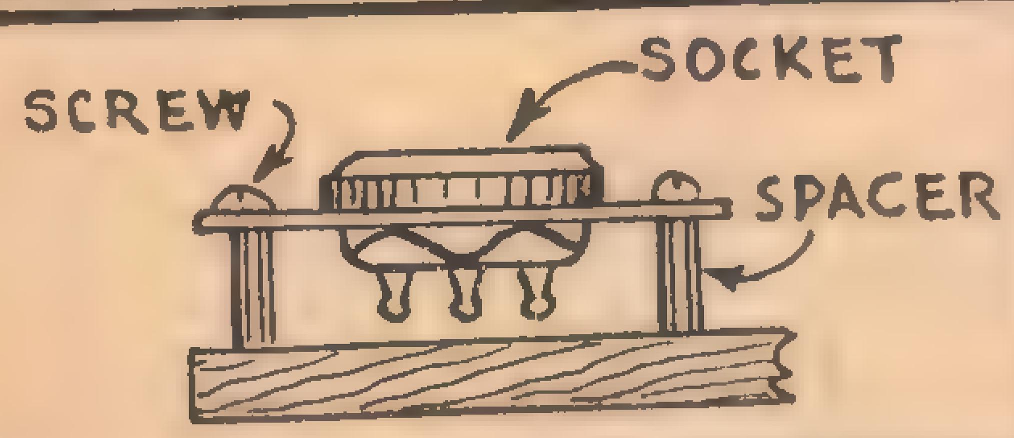
An efficient circle cutter can be made by drilling two parallel holes through a bolt. The centres of the holes should be the same distance apart as the radius of the desired circle. A centre drill is passed through one hole and a cutter through the other. Hold in place with two nuts as per sketch.



WIRE CONNECTORS

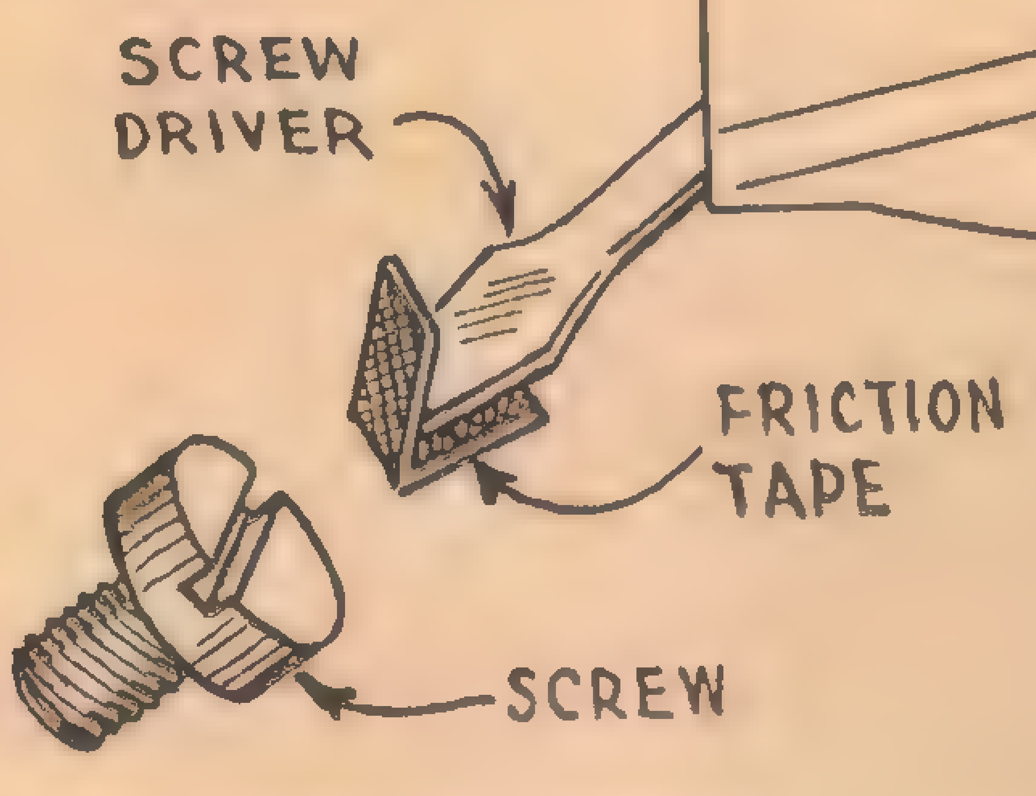
By fastening a number of paper clips to a piece of wood by means of screws and washers, wires can be quickly joined by slipping under the clip ends. By joining the other ends of the clips series, parallel and series parallel connections can be worked out.





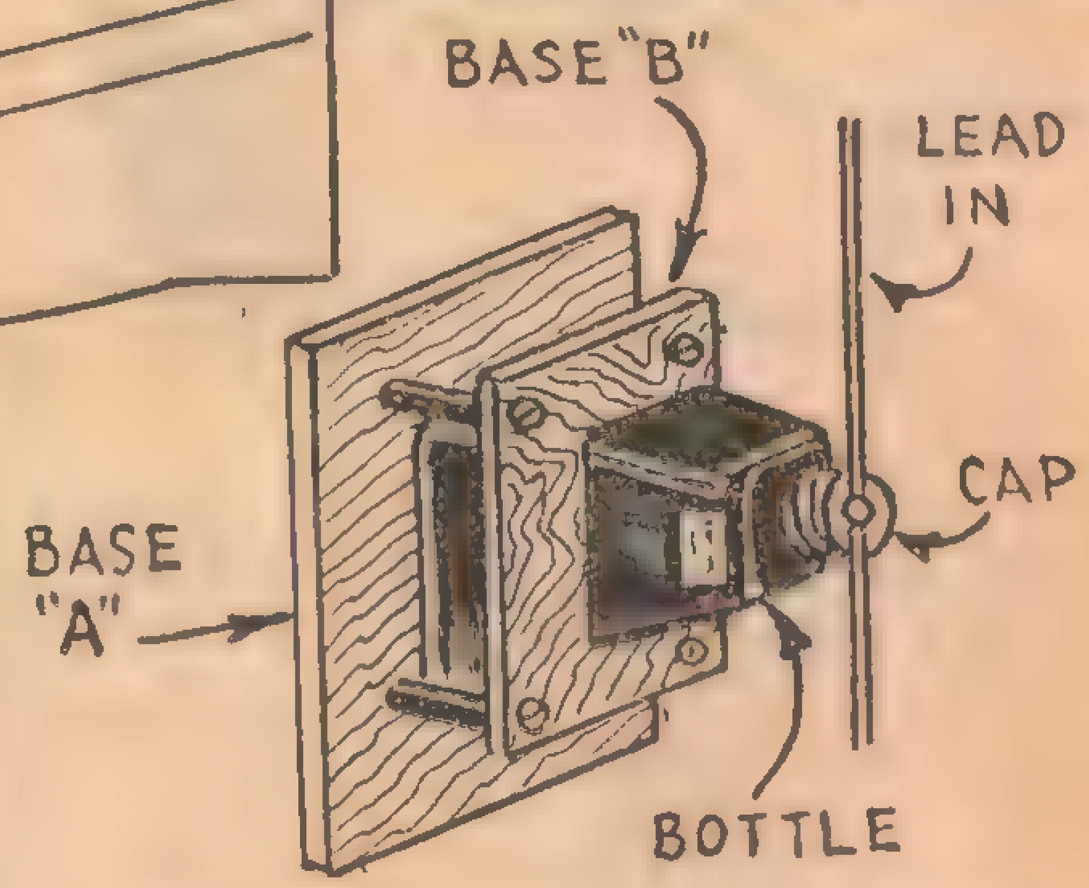
SOCKET MOUNTING

While experimenting with hook-ups on wooden base boards, chassis mounting type sockets can be easily used, mounting them by means of two hollow spacers and two wood screws; shown in sketches at left.



SCREW HOLDER

If you experience trouble in getting a screw into some awkward spot on a chassis, try placing a small piece of friction tape over the blade of the screw-driver. This will hold the screw till it is screwed home.



STAND-OFF INSULATOR

Studying the accompanying sketch, an efficient stand-off insulator is easily made from a suitable bottle, two wooden bases and a few screws. Make sure the inside of the bottle is dry and also seal the screw cap with a little shellac.

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Complete list available on application.

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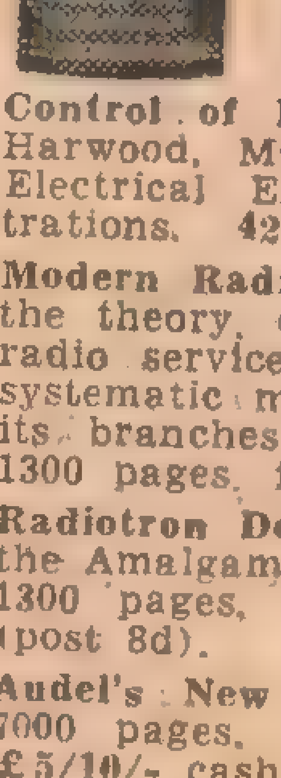

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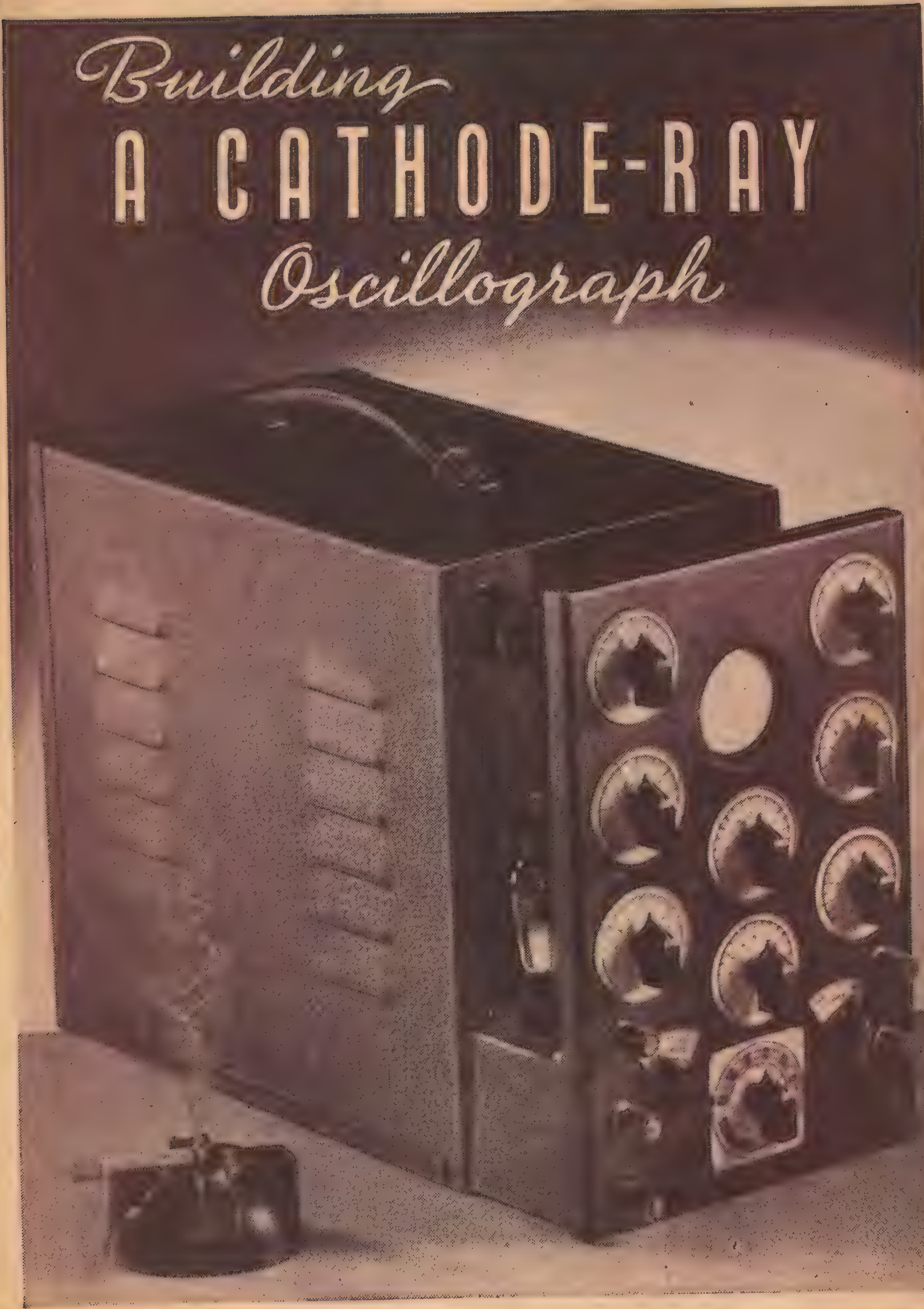

Building
A CATHODE-RAY
Oscillograph

FULL CONSTRUCTIONAL DATA FOR THE

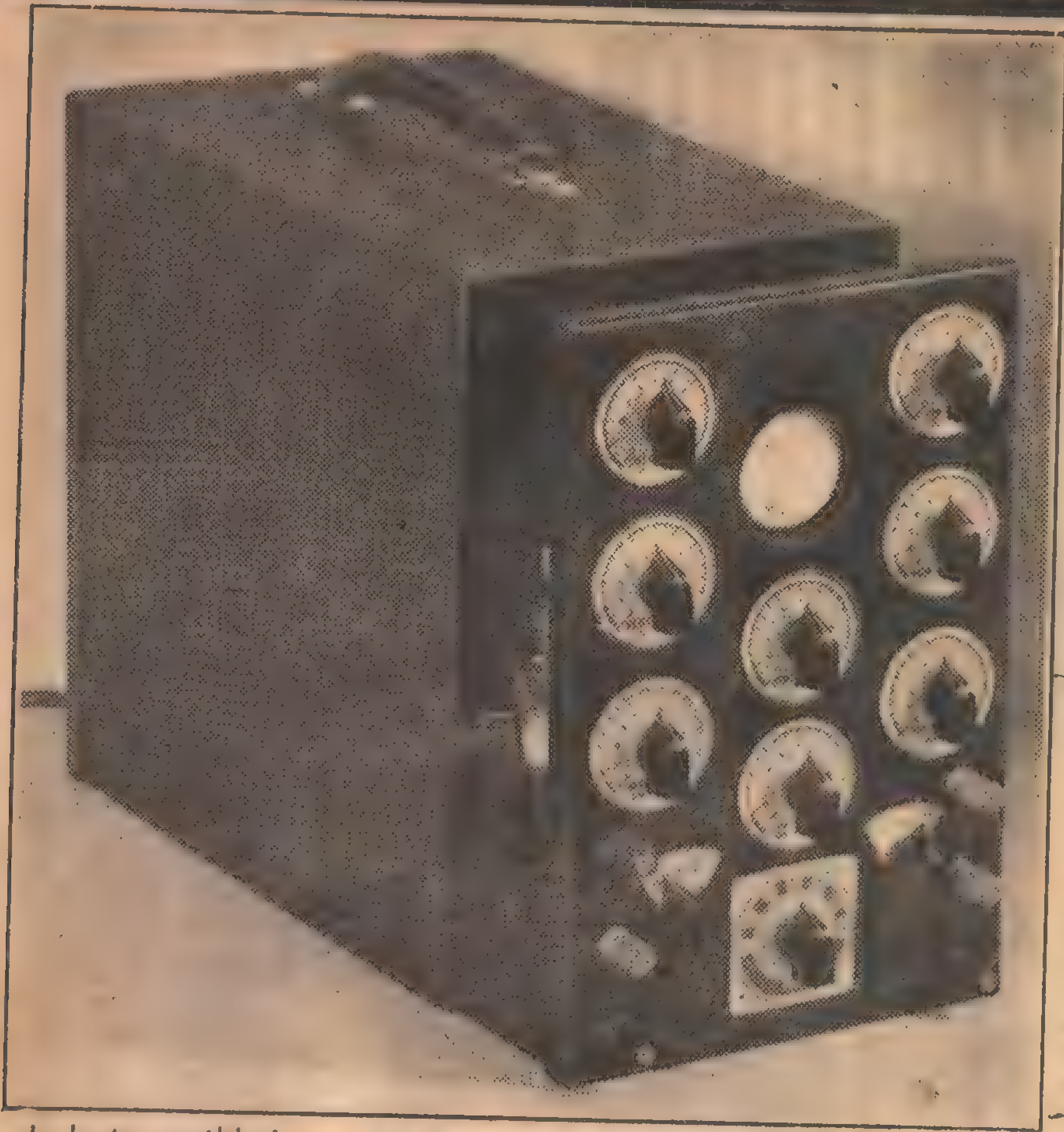


Figure 1. Here is the completed instrument, the chassis being pulled out a little from the case. The case of the original was finished with a black crackle, the panel being a polished black. The performance of the instrument is such as to warrant some expenditure on the external appearance.

In last month's issue we presented an article dealing at some length with the general theory of a typical cathode-ray oscillograph. In this article, it is proposed to give full constructional data for a cathode-ray oscillograph using the two-inch type 902 C.R. tube. The data can be filed for future reference.

by

H. R. Harant

THOSE who studied last month's article will agree that it is not a particularly difficult matter to understand the basic principles of this most useful instrument. As we proceed, you will see that the majority of the parts used are standard radio components. In fact, quite a few of them will probably be found to be on hand.

There remain a few minor theoretical points to be discussed, and these will be dealt with as we go along.

The first thing to be obtained is the chassis. The accompanying diagram is exactly to scale to the original template and it should not be unduly difficult to obtain a chassis exactly the same as the original.

If you should have to get it made from some place not accustomed to making chasses, it would be a good idea to redraw the diagram full size, including all the important measurements. While so doing, any necessary adjustments could be made for different components and the various small mounting holes marked in. Be careful to stipulate the diameters required.

As can be gathered from the diagram, the chassis itself actually consists of three separate parts, which are welded together as to form one unit. It is obvious from the various photos how this is done.

There are two points worth special mention. Firstly, on the back of the front panel goes a 1in. rim, around the circumference of the 2 1-8in. hole. This allows for small discrepancies in the physical length of the C.R. tube and permits the screen of the tube to be located slightly behind the level of the front panel.

This helps quite a lot when using the instrument in a room under full daylight conditions. It also protects the cathode-ray tube against accidental damage.

LEAVE GAP FOR CASE

The second important point is the small gap on each side between the actual chassis and the turnover of the frontplate. This gap must be just wide enough to permit the cover to slip in between the chassis and the frontplate. If 16-gauge steel is used, as in the original, a 1-16in. gap must be allowed for.

The first step in assembly is to mount the controls. They are as follow: In the top left corner is the Control R10, which is the intensity control. In the top right-hand corner is R8, the focus-control.

Immediately below these two are fitted the two special spot-shift controls, R28 and R29. The switches, which are visible on the back of these controls, were made ineffective by opening the control and reassembling it again after the switches had been thrown in the "off" position. It so happened that these controls were on hand and were used instead of buying two new controls.

Underneath the two spot-shift controls are the potentiometers for controlling vertical and horizontal gain (R20 and R19 respectively).

SWEEP CIRCUIT CONTROLS

Down the centre of the front panel three knobs can be distinguished. The upper knob controls the amount of synchronisation voltage fed to the grid of the gas-discharge tube (R11).

The bottom knob is fitted to the shaft of the 8 position-switch (S3) for the coarse adjustment of the sweep frequency.

The fine adjustment control R15 is situated in the centre between these two. To the left and right of it are the two semi-rotary switches, S1 and S2.

After mounting the controls, there remain the six terminals, three on each side. The two bottom terminals are black and are earthed internally to the chassis. The middle terminals provide the input for the vertical and horizontal deflection amplifiers.

The top right-hand terminal is connected through C28 to the 50 c/s AC. The upper left-hand terminal goes to

TWO-INCH CATHODE-RAY OSCILLOGRAPH

the switch S1 to permit external synchronisation of the sweep-generator.

The inclusion of these two last-mentioned terminals is unusual, but we are sure that everyone who has ever found out their value will not want to do without them.

USE POINTER KNOBS

Using a clockface as a guide, the knobs should all be locked in such a way that they are pointing to 7.30 when they are turned right off. This gives a very neat appearance to the finished job.

Pointer knobs, by the way, are very important, and we could say even essential for the proper use of the apparatus. They indicate at a glance the working condition of the whole equipment. The doubting reader may be kindly reminded that eleven pointer knobs are a lot cheaper than a new 902.

In the event of semi-rotary S.P.D.T. switches being unobtainable, ordinary toggle switches of the same type can be substituted instead.

Also, we would mention that the dials for the different controls were hand-drawn with black Indian ink and covered with small celluloid discs to protect them being torn off or becoming dirty. They are simply held in place by the locknut of the controls.

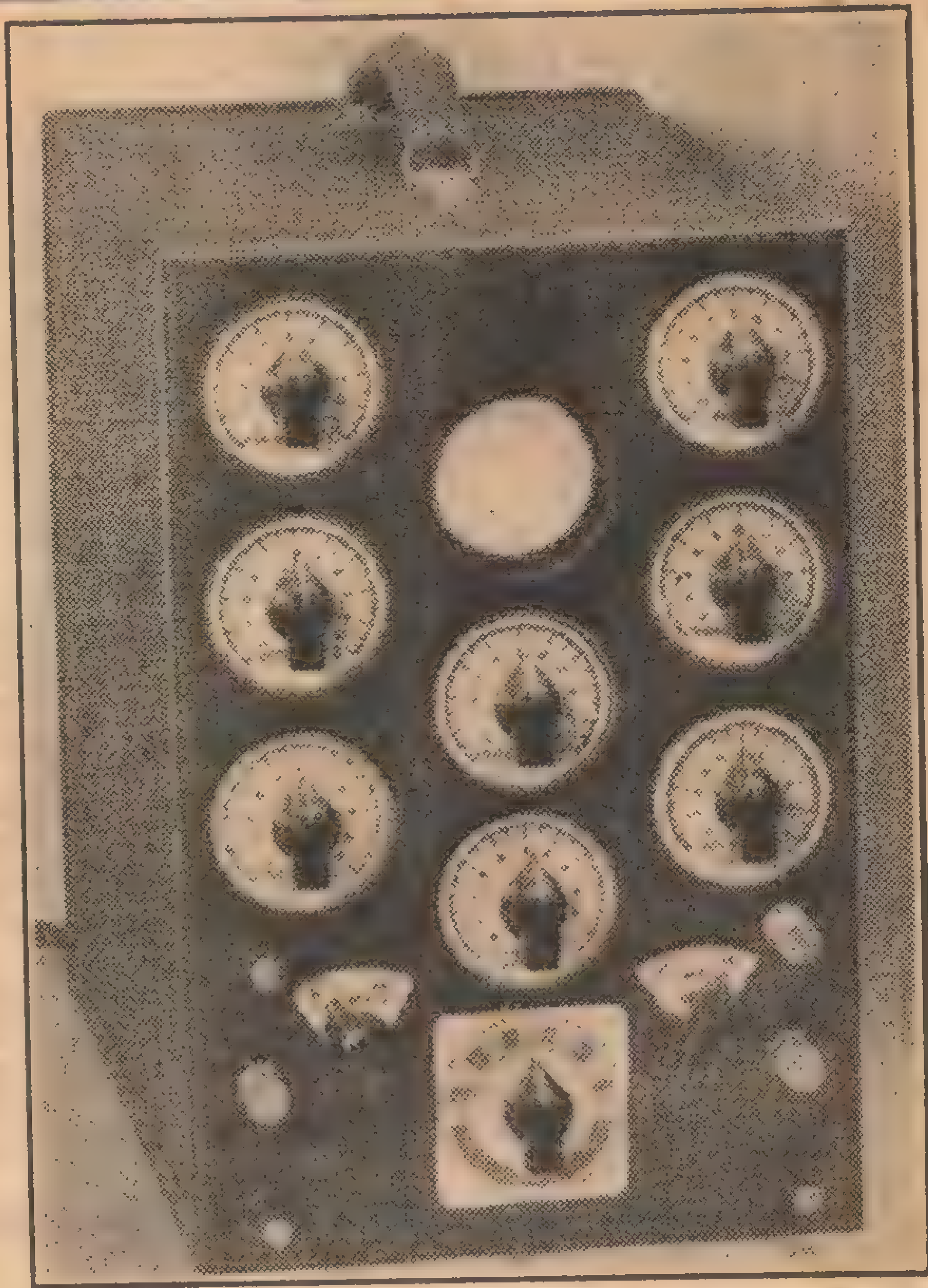


Figure 2. Looking on the panel of the Two-Inch Cathode - Ray Oscillograph. From top to bottom, the controls on the left are as follow: Intensity, Vertical Spot Shift and Vertical Gain. The three on the right are: Focus, Horizontal Spot Shift and Horizontal Gain. Down the centre there is the Synchronisation Control and the Fine and Coarse Sweep Frequency Controls. The semi-rotary switch on the left is for internal and external synchronisation, and that on the right for internal and external sweep. The various terminals are for the input to the two amplifiers, for the external synchronisation voltage and for the 50-cycle sweep voltage.

MOUNTING THE SOCKETS

After mounting the controls the next thing is to fix the sockets for the different valves. In the original instrument we used metal and glass valves, according to what we had on hand.

Many of our readers will, no doubt, do likewise, although some will prefer to have everything uniform.

The tubes recommended are two type 6J7-G, one 884, one 80 and one 5Y3-G. Except the 80, all tubes are of the octal-based variety. This provides spare contacts on the sockets and helps to obviate the necessity for terminal strips, which did not prove very successful.

When building the original oscilloscope, we thought it a good idea to arrange all the major parts on a common terminal strip—this was later on followed by another one—in order to simplify wiring and layout. Unfortunately, this was an unwise decision.

TERMINAL STRIPS

As can be clearly seen from the underneath photograph, one terminal strip is located to one side of the chassis and the other across the centre of the chassis. The latter one contains only the condensers C1 to C7, which constitute the course adjustment for the horizontal sweep.

This particular terminal strip is very useful and should be retained, since it is a convenient method of mounting the comparatively large number of condensers.

They could, of course, be mounted around the rotary switch but, as several capacitances had to be made up by two smaller condensers, this is not a convenient way of doing things.

But let us get back to the description of the assembly of the components. Fig. 5 is a view looking directly on top of the chassis. The amplifier valves can be seen right next to the front panel. Note also the gap between the front panel and the chassis.

This gap greatly simplifies the wiring. Without the gap, all the wiring to the different controls would have to be brought, through a number of separate holes in the chassis, to the back of the front panel. Also, one would lose a considerable amount of useful space for potentiometers, &c., on the front panel.

BEFORE going ahead with this series of articles, we were careful to ascertain that there were what we considered ample stocks of type 902 and 884 valves available. Unfortunately, between the time that the inquiries were made and the time that the April issue appeared on the streets, almost the whole of the available stock was absorbed for a special purpose. As a result of this it is likely that many of our readers will find it impossible, for the time being at least, to purchase the necessary tubes. This is all the more disappointing to us in view of the keen interest which the article created among enthusiasts and servicemen generally. However, we will go on with the series just the same so that they will be available when the tubes finally come to hand.

CHASSIS LAYOUT

On the left-hand side, in the centre, is the gas triode. Towards the rear are the two rectifiers, one on either side of the chassis. Between these, the support for the C.R. tube is welded in place. This support fits directly over the small cut-out in the centre of the chassis base. Once again, this cut-out permits easy passage of the leads to the base of the C.R. tube.

This support not only holds the C.R. tube, but also supports a terminal strip, giving access directly to the deflector plate pins of the tube. A hole in the back of the cover allows the terminals to protrude.

Unfortunately, this panel was not mounted at the time when the photos. were taken, but the necessary measurements and diagrams are given at the end of this article. This feature is by all means worth incorporating, as it permits direct access to the deflector plates for special experiments.

(Continued on Next Page)

★ COMPLETE SCHEMATIC CIRCUIT DIAGRAM ★

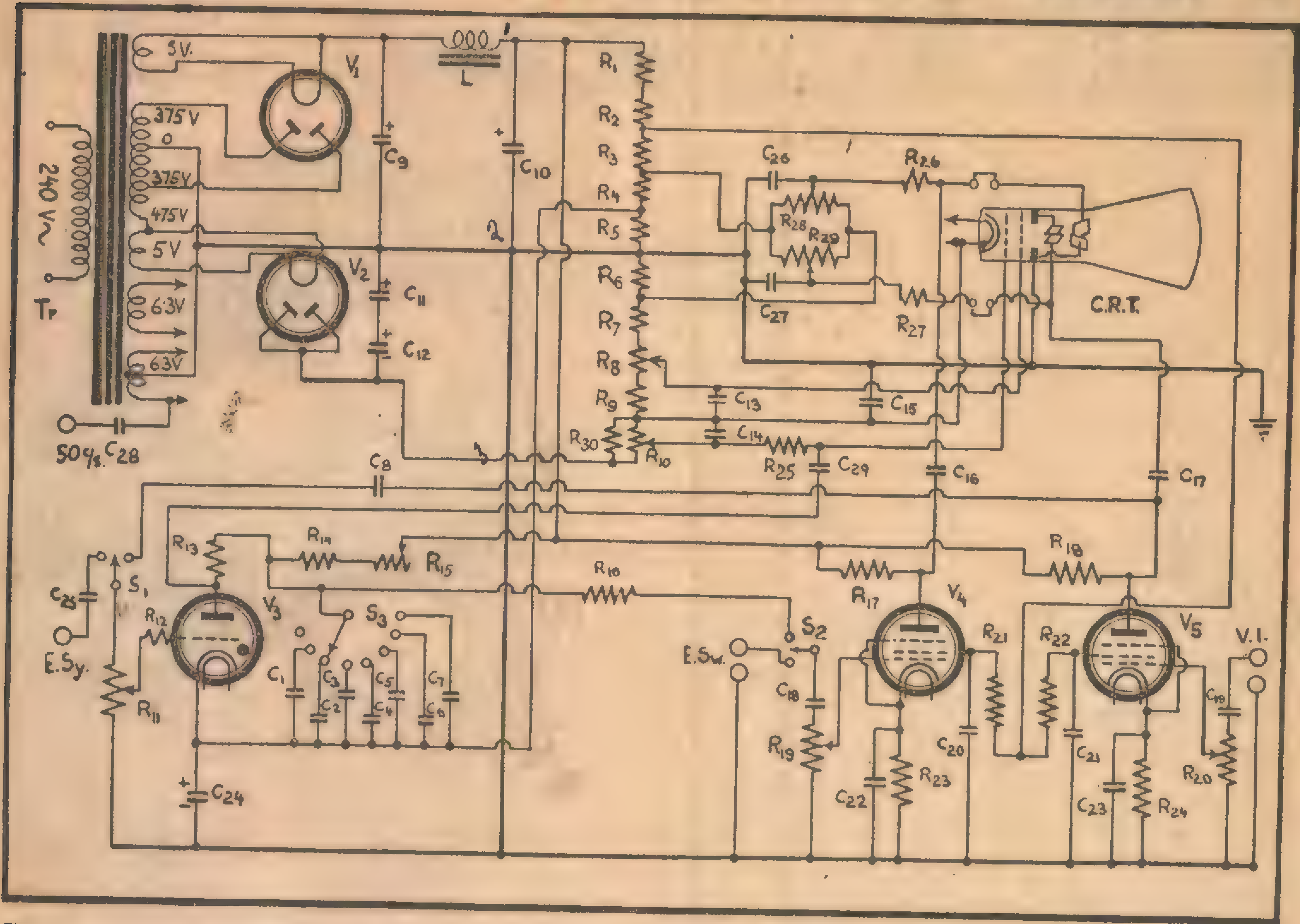


Figure 3. Here is the complete circuit diagram of the Two-Inch Cathode-Ray Oscillograph. One or two minor corrections, mentioned in the explanatory notes beneath the circuit in the April issue, have duly been made. The values for the various components are given in the parts list below.

COMPLETE LIST OF PARTS AND KEY TO CIRCUIT VALUES

RESISTORS

R1 10,000 ohm 2 watt resistor.
R2 15,000 ohm 2 watt resistor.
R3 5000 ohm 1 watt resistor.
R4 15,000 ohm 2 watt resistor.
R5 600 ohm 1 watt (wire wound).
R6 50,000 ohm 1 watt resistor.
R7 50,000 ohm 1 watt resistor.
R8 25,000 ohm potentiometer.
R9 15,000 ohm ½ watt resistor.
R10 1 megohm potentiometer.
R11 250,000 ohm potentiometer.
R12 25,000 ohm ½ watt resistor.
R13 500 ohm 1 watt resistor.
R14 250,000 ohm 1 watt resistor.
R15 1 megohm potentiometer.
R16 1 megohm ½ watt resistor.
R17 100,000 ohm 1 watt resistor.
R18 100,000 ohm 1 watt resistor.
R19 1 megohm potentiometer.
R20 1 megohm potentiometer.
R21 250,000 ohm ½ watt resistor.
R22 250,000 ohm ½ watt resistor.
R23 1000 ohm 1 watt resistor.
R24 1000 ohm 1 watt resistor.
R25 1 megohm ½ watt resistor.
R26 2 megohm ½ watt resistor.
R27 2 megohm ½ watt resistor.
R28 1 megohm potentiometer.
R29 1 megohm potentiometer.
X R30 25,000 ohm ½ watt resistor.

CONDENSERS

C1 0.0008 mfd mica condenser.
C2 0.002 mfd mica condenser.
C3 0.005 mfd mica condenser.
C4 0.015 mfd mica condenser.
C5 0.05 mfd paper condenser. 600PV.
C6 0.15 mfd paper condenser. 600PV.
C7 0.5 mfd paper condenser., 600 PV.
C8 0.001 mfd mica condenser.
C9 8 mfd dry electrolytic con., 600 PV.
C10 8 mfd dry electrolytic con., 600 PV.
C11 8 mfd dry electrolytic con., 600 PV.
C12 8 mfd dry electrolytic con., 600 P.V.
C13 0.1 mfd 400 V paper con.
C14 0.1 mfd 400 V paper con.
C15 0.1 mfd 600 V paper con.
C16 0.25 mfd 400 V paper con.
C17 0.25 mfd 400 V paper con.
C18 0.25 mfd 600 V paper con.
C19 0.25 mfd 600 V paper con.
C20 0.25 mfd 400 V paper con.
C21 0.25 mfd 400 V paper con.
C22 0.003 mfd mica con.
C23 0.003 mfd mica con.
C24 25 mfd 40 PV electrolytic con.
C25 0.25 mfd 600 V paper con.
C26 0.1 mfd 400 V paper con.
C27 0.1 mfd 400 V paper con.
C28 0.25 mfd 400 V paper con.
C29 0.0005 mfd mica con.

VALVES

V1 '80 valve.
V2 '80 valve.
V3 884 valve.
V4 6J7G valve.
V5 6J7G valve.

OTHER COMPONENTS

L 30 Henry 15 ma choke.
Tr Transformer as specified in text.
S1 SPDT semi-rotary switch.
S2 SPDT semi-rotary switch.
S3 12-position rotary switch.
6 terminals.
2 terminal strips for mounting.
11 black pointer knobs.
2 4-pin valve sockets.
4 octal valve sockets.
1 special chassis.
Solder, solder lugs, ⅛in. bolts and nuts, mains cord, hook-up wire, bus bar.

X p.45.

The socket for the 902 fits the hole in the support. You will notice that the so-called "manufacturing type" amphenol socket is used, instead of the ordinary type. It is fitted in a special plate, which is supplied, on request, together with the socket.

This socket permits the tube to be adjusted by means of the two slots which take the screws to hold the socket. They should be tightened up after the tube has been adjusted so that the line, traced by the luminous spot due to the sweep voltage, is exactly horizontal. This, of course, must be done after the job has been completed. Small washers will help to keep the socket tightly in the correct position once it has been adjusted.

USE "STAR" WASHERS

One point, which has been mentioned in this magazine before, is well worth repeating on this occasion. We refer to the use of so-called "rattle-proof" washers, also known as internal and external "star" washers, according to their shape.

The reader would be surprised to see what a short journey, especially by car, can do to a piece of apparatus in which the nuts are not securely locked in place by suitable washers. These washers are very cheap and should not be missed by any serious experimenter.

And now back again to the chassis. Behind the CR tube support we find the power transformer and the filter choke, mounted in the usual fashion. The two cores are, as mentioned in our last article, mounted at right angles to each other.

Figure 4. Looking on one side of the chassis. The three valves in line are the 6J7 horizontal amplifier, the gas-triode and the 5Y3-G rectifier. Note the 1-inch steel rim around the screen end of the CR tube. This is included to allow the tube to be recessed behind the panel and to avoid the necessity of resting the glass wall of the tube on the edge of the panel.

Unfortunately, this does not show quite clearly in the photographs, as the choke has a metal shield. The latter provides protection for the windings and facilitates mounting. It does not provide magnetic shielding, since for this, heavy material would be necessary.

Now have a look at the underneath view of the chassis. The power transformer can be clearly seen, with the outlet from the choke to the right. The five valve sockets can also be distinguished, three on the right-hand side and two on the left.

The centre terminal strip carries the condensers for the sweep oscillators. On the extreme right is condenser C7, which had to be made up from two 0.25 mf condensers, followed by a 0.1 mfd and 0.05 mfd in parallel for the value 0.15 mfd (C6). Then follows one 0.05 mfd (C5).

Next comes a combination of 0.01 mfd plus 0.005 mfd, constituting C4. C3 is a single 0.005 mfd condenser. C2 is a 0.002 mfd, which is also readily available. C1 had to be made up from three condensers, 0.0005, 0.0002 and 0.0001 mf, as no other values were available.

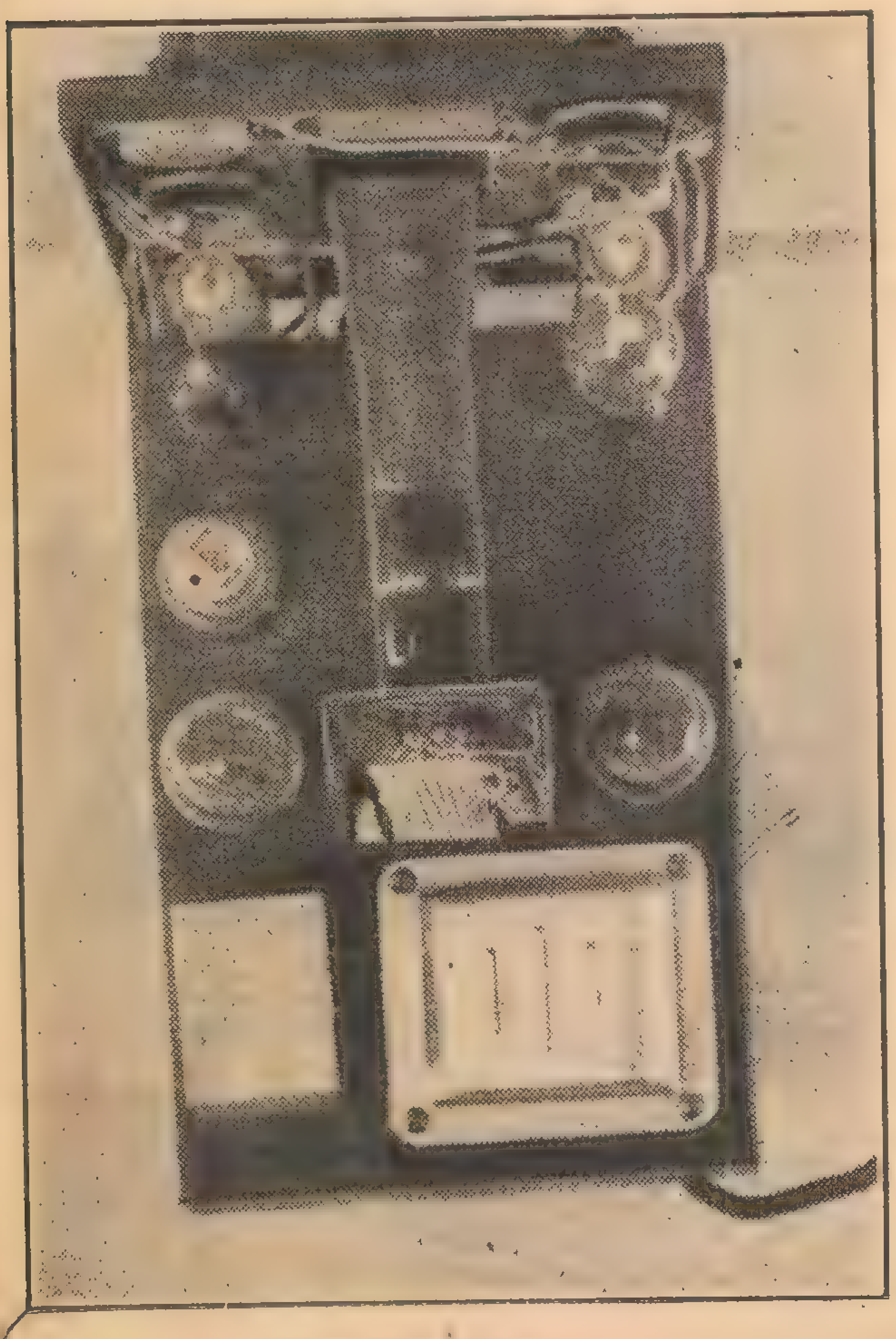


Figure 5. A top view of the chassis. Note particularly the space between the top of the chassis proper and the rear of the front panel. This facilitates wiring and allows a more symmetrical panel layout. Note also the bracket supporting the base of the CR tube and the cutout in the chassis for the leads to the CR tube socket.

WATCH VOLTAGE RATINGS

Obviously, if other combinations or simplifications can be introduced, this is quite in order. Only remember that the voltage across the condensers fluctuates over a range of nearly 450 volts. Therefore the d-c working voltage rating of the paper condensers C5, C6 and C7 should not be lower than 600 volts.

The second terminal strip contains practically all the other parts of both amplifier and of the sweep generator. Furthermore, all the resistors for the voltage divider network are mounted on this strip. This crowding of components gives rise to undesirable coupling effects at the highest frequencies.

For this reason, it is preferable to mount the individual groups of the components on separate strips to minimise unwanted coupling. The wiring will be rearranged in the original model as soon as time permits.

On the panel of the transformer we see quite a number of lugs which are apparently not used. This particularly applies for the row of lugs on the side nearest the front of the chassis. The original job was intended to be truly versatile, and provision was made for controlling the primary input voltage in 5-volt steps from 165 to 260 volts. Hence the specially tapped primary winding on the transformer.

(Continued on next page.)

UNDERNEATH VIEW OF CHASSIS

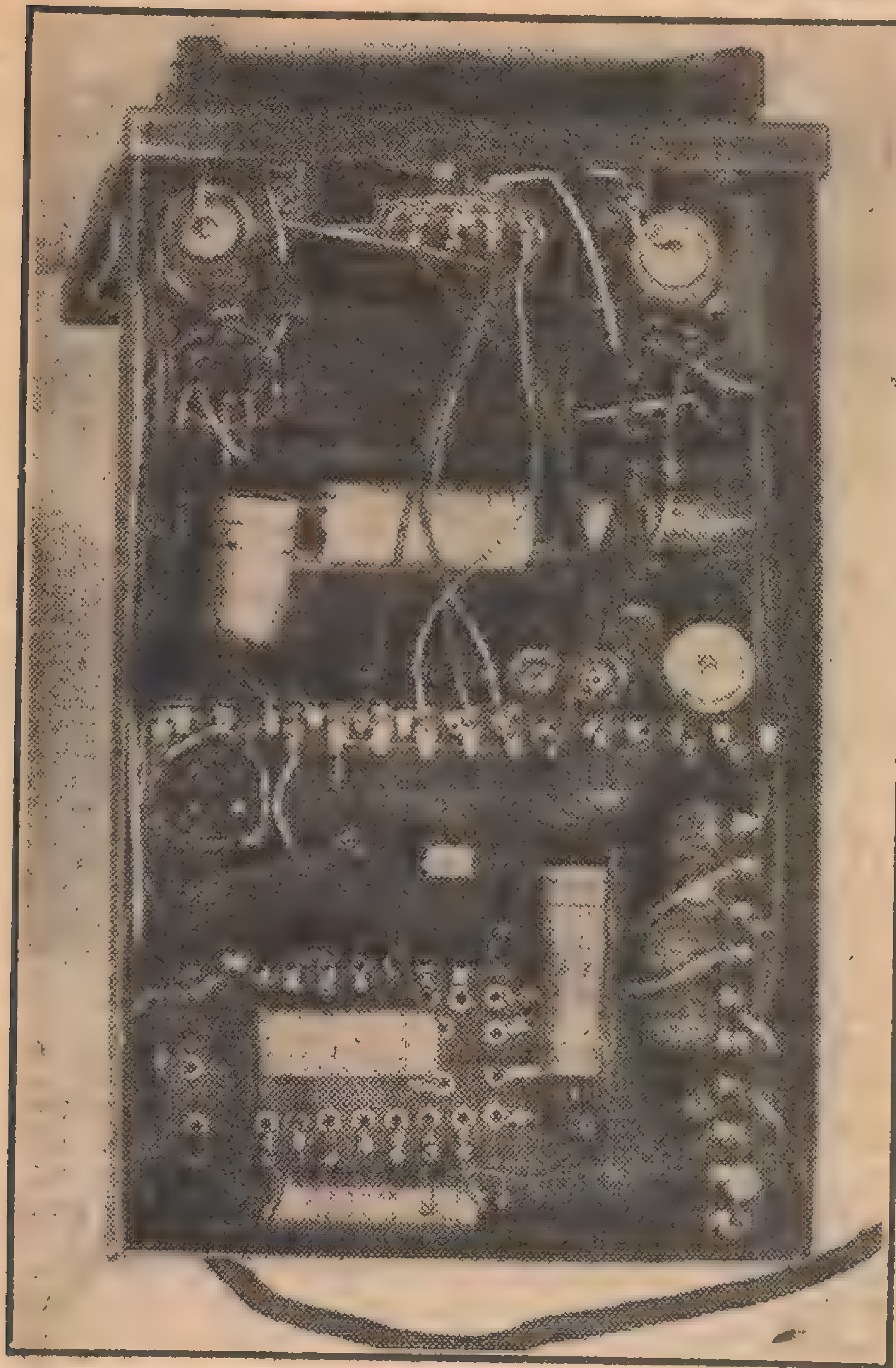


Figure 6. Here is an underneath view of the chassis. The terminal strip across the centre of the chassis carries the various condensers for the sweep oscillator circuit. The other terminal strip on the side carries many of the components for the two amplifiers. As explained in the text, it was found that there was a certain amount of undesirable coupling, as a result of this method of wiring, and it is suggested that separate panels be used for the two amplifiers in order to avoid this. The large number of lugs seen on the power transformer panel include the many tappings for the primary winding. This point is discussed in the text.

This was done, as there are appreciable variations in line voltage, particularly in Melbourne and its suburbs, where voltages of from 175 to 190 volts are not uncommon. The tappings are 0, 5, 10, 15, 180, 200, 220, 240 and 260 volts.

This, of course, is only necessary where such difficult conditions may be expected. Otherwise a normal 220, 240, 260 should be sufficient. The remaining lugs are for the various secondary voltage outlets.

FILTER CONDENSERS

The condenser tucked away behind the power transformer is the first electrolytic condenser on the cathode of V1, namely, C9. C10 is mounted to the right of the transformer, near to the choke. On top of the terminal plate is the condenser C15, which bypasses the cathode of the CR tube to earth.

Next to the 80 socket are the two condensers, C11 and C12, which are connected in series. Remember that the positive side of the supply is earthed and the negative end goes to the two bridged anodes of the rectifier V2.

Alongside C11 is R24, the cathode resistor for V5. It is just possible to make out the small condenser C23 nearby on the extreme left of the chassis.

In the first article, the most important theoretical details were discussed at length. However, a few of the smaller items still remain to be mentioned. For instance, there is the resistor R25 and the capacitance C29. These are included for the purpose of blacking out the "fly-back" trace.

The technical explanation of this and its advantages will be explained here, before we continue with the description of the remainder of the apparatus.

As mentioned in our first article, if we apply a negative voltage to the grid of the CR tube, we find that the number and the velocity of electrons striking the fluorescent screen will be decreased. The net result is to reduce the brightness of the spot.

FLY-BACK TRACE

Let us assume that the spot is travelling from left to right with a certain speed. As soon as it reaches the extreme right-hand position, the condenser in the sweep-circuit begins to discharge and the spot returns to its starting position.

This return to the starting position or the "fly-back," as we call it, necessarily takes a certain amount of time. The fly-back time is determined mainly by the rapidity by which we can discharge the condenser, or, in other words, by the apparent resistance of the discharge device.

Obviously, the more rapidly the spot travels back across the screen, the lower will be the brightness of the return trace. The time occupied by the spot in returning to the starting position should be only a very small fraction of the time taken to traverse the screen from left to right.

Since the discharge or fly-back time remains fairly constant for all sweep frequencies, the greatest difficulty is encountered at high sweep frequencies. Without any special blacking out device it will always be noticeable, and can, under unfavorable conditions, completely upset the pattern on the screen.

BLACKING-OUT THE RETURN TRACE

To cut out the trace on its way back, all we have to do is to apply a negative bias to the grid of the C.R. tube at the instant the gas relay starts conducting. This would be complicated if the sweep voltage were an ordinary sine wave. But, being a triangular curve, this can be achieved comparatively easily.

If we have a look at figure 11 in last month's issue, we notice how the voltage at first rises gradually and then falls off very suddenly. We can now consider these two parts of the curve as two different frequencies, one low, the other one very much higher.

Now we know that the impedance of any condenser is inversely proportional to frequency. The higher the frequency, the lower is the impedance, and vice versa. This fact allows us to make use of a condenser for the purpose of accepting or utilising certain frequencies present in a circuit, rejecting other frequencies present in the same circuit.

A RESERVATION

Before proceeding further, we must say that it is not strictly correct to speak of any portion of a triangular waveform in terms of a single frequency. Rather does it consist of a combination of innumerable frequencies which combine to impart to it the particular shape.

However, there are distinctly different frequency components in the various portions of the waveform, and the idea of frequency rejection by a condenser still holds good.

However, to continue: When the voltage rises according to the first part of the curve, the potential applied to one plate of C29 rises comparatively slowly, depending on the sweep frequency. This would induce a similar rise on the grid of the C.R. tube; however, to avoid this, the resistor R.25 is inserted.

METHOD OF OPERATION

Immediately the voltage starts to rise, it initiates a current through this resistor. The smaller the value of the resistor, the quicker the charge is conducted to earth and also the smaller the voltage developed across the resistor.

If the component values are chosen wisely and with due respect to the sweep frequencies, the voltage across R25 will be quite small. Furthermore, it will be positive and so tend to make the image brighter.

During the fly-back period, different conditions hold. The voltage does not change gradually, giving ample time to be conducted to earth via the resistance R25.

On the contrary, it changes very rapidly, allowing a much higher voltage to be developed across the resistance R25. The voltage developed makes the grid negative with respect to cathode, thus periodically blocking the current in the C.R. tube. It is obvious that the value of these two components, namely the resistor R25 and the condenser C29 is of paramount importance to the efficient functioning of the scheme.

DISADVANTAGES OF THE SCHEME

One or two minor disadvantages should be mentioned. It is found that the tendency to make the grid of the C.R. tube positive, when travelling from left to right, increases the brilliance of the image at the higher sweep frequencies. This necessitates a change in the setting of the intensity control.

There is also a residual effect when the internal sweep is switched off by means of S2. The gas relay will still be in operation and will introduce some voltage to the grid of the C.R. tube.

It is very easy to see the effect of the cut-out, when the sweep oscillator is not in use. Simply connect the input for the vertical plates to the 50 cycle terminal. Also connect the input for the horizontal plate to the 50 cycle terminal through a .0005 mfd condenser, at the same time connecting a fairly high resistance between this terminal and earth.

We obtain in this way a so-called phase-shifting network and the image on the screen will be an ellipse.

If we now adjust the sweep circuit to about 50 traces per second, we will see one dark space in the ellipse. Actually it is a very small part missing out of the line. If we adjust to 100 cycles, then two such spaces appear and so on. The faster the sweep becomes, the more breaks appear.

SWITCH OFF THE SWEEP OSCILLATOR

Obviously, such breaks are a nuisance and it is disconcerting to see those dark spots flickering in the image, while the horizontal sweep is not in use. For this purpose the eighth position is provided on the switch S3. If the switch is turned to this position and also the fine-adjustment control to minimum resistance, the tube will cease to ignite and no longer operate.

So much for the fly-back cut out. If it is found that the action is too pronounced and that it interferes with the proper working of the sweep, we suggest decreasing R25 to 100,000 ohms. Decreasing C29 has much the same effect.

While on the subject of theory, the resistor R13 is worthy of special mention. Its function is to limit the peak

DIMENSION DIAGRAMS OF CHASSIS & PANEL

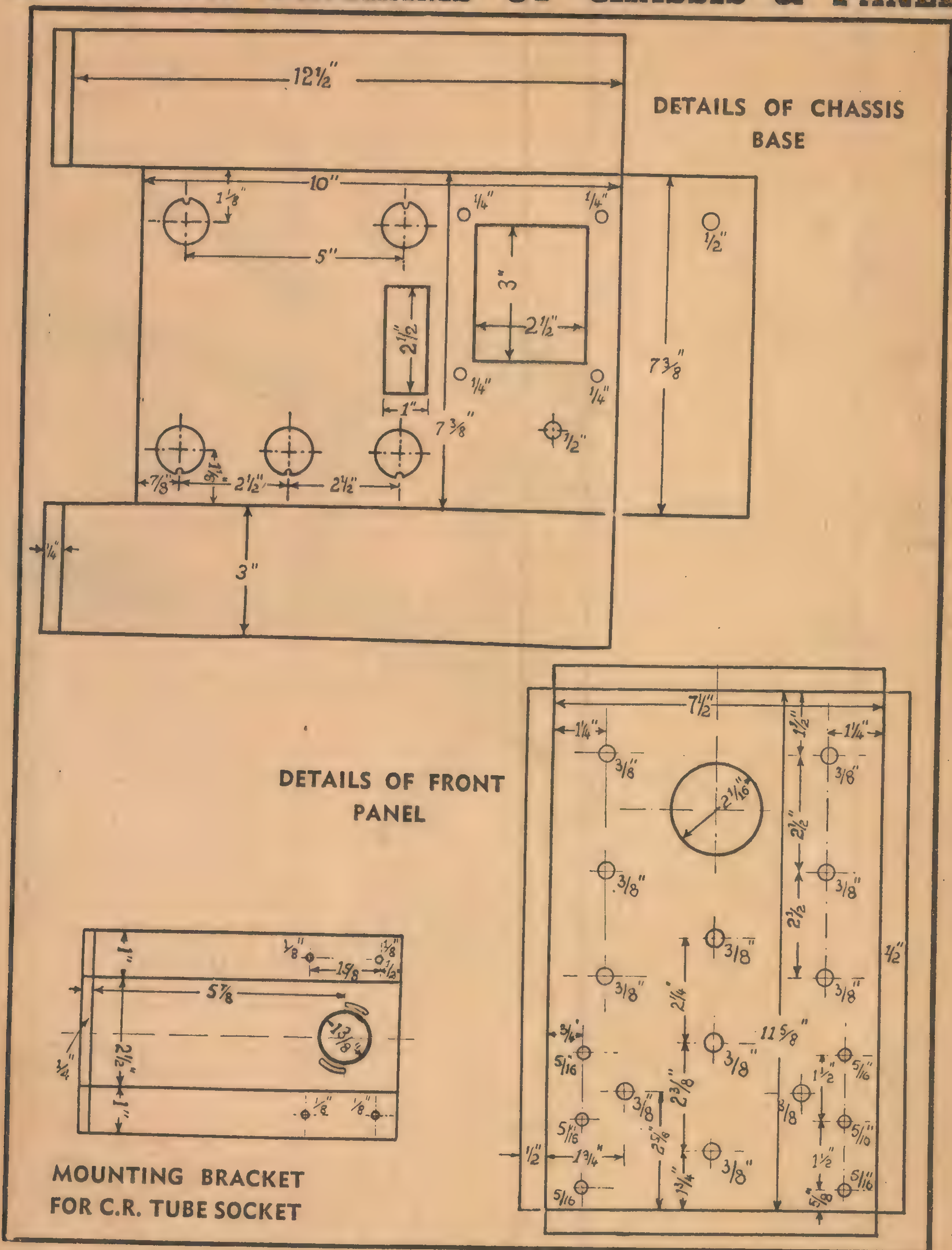


Figure 7. Here are the essential measurements of the original chassis, panel and support bracket for the CR tube. When ordering a special chassis of this nature, we suggest that to avoid mistakes and confusion, you draw a full-size template, marking all dimensions and incorporating any changes necessary to suit the individual components, which you choose.

rrent passed by the gas discharge be.

When the condenser C1 to C7 is suffi- ntly charged, the tube ionises and gins to conduct. As stated in our t article, the resistance of such a be, once the current starts to flow, very small.

Now, imagine the effect of placing a tential of some hundreds of volts ross a tube having a very small re- tance. The instantaneous peak cur- nt would be enormous, and possibly fficient to jeopardise the life of the be.

The limiting resistor, R13, ensures at the peak current will never rise ove a certain limit, which is per- issible for the particular type of lve. It should not be omitted; even it appears that the performance is in way impaired or even apparently proved without it.

IRING THE CONTROLS

After assembling the various parts n the chassis base, and wiring up the ajor components and the filament onnections, the next job is to wire up he controls. The intensity control as also equipped, in the original, with mains switch, which is very useful. he intensity control is wired in such way as to decrease the bias on the rid by turning it in a clockwise direc- ion.

It will be found that this control is omparatively critical. Unfortunately his can't be helped, as the optimum oint for different valves varies con- iderably. By decreasing R30, some mprovement can be effected. However, when the tube has to be changed, it is ossible that readjustments to the valve nay be necessary.

It is possible to use a 25,000 ohm car- bon control instead of R30 and R10 in parallel. In our case, the 1 meg con- trol was the only one available with an off-on switch on the back. This built-in off-on switch is not permitted by certain authorities and you will have to decide the matter for yourself. After all, it may be dangerous to touch any parts inside the instrument while the mains potential is still present in- side the chassis.

THE FOCUS CONTROL

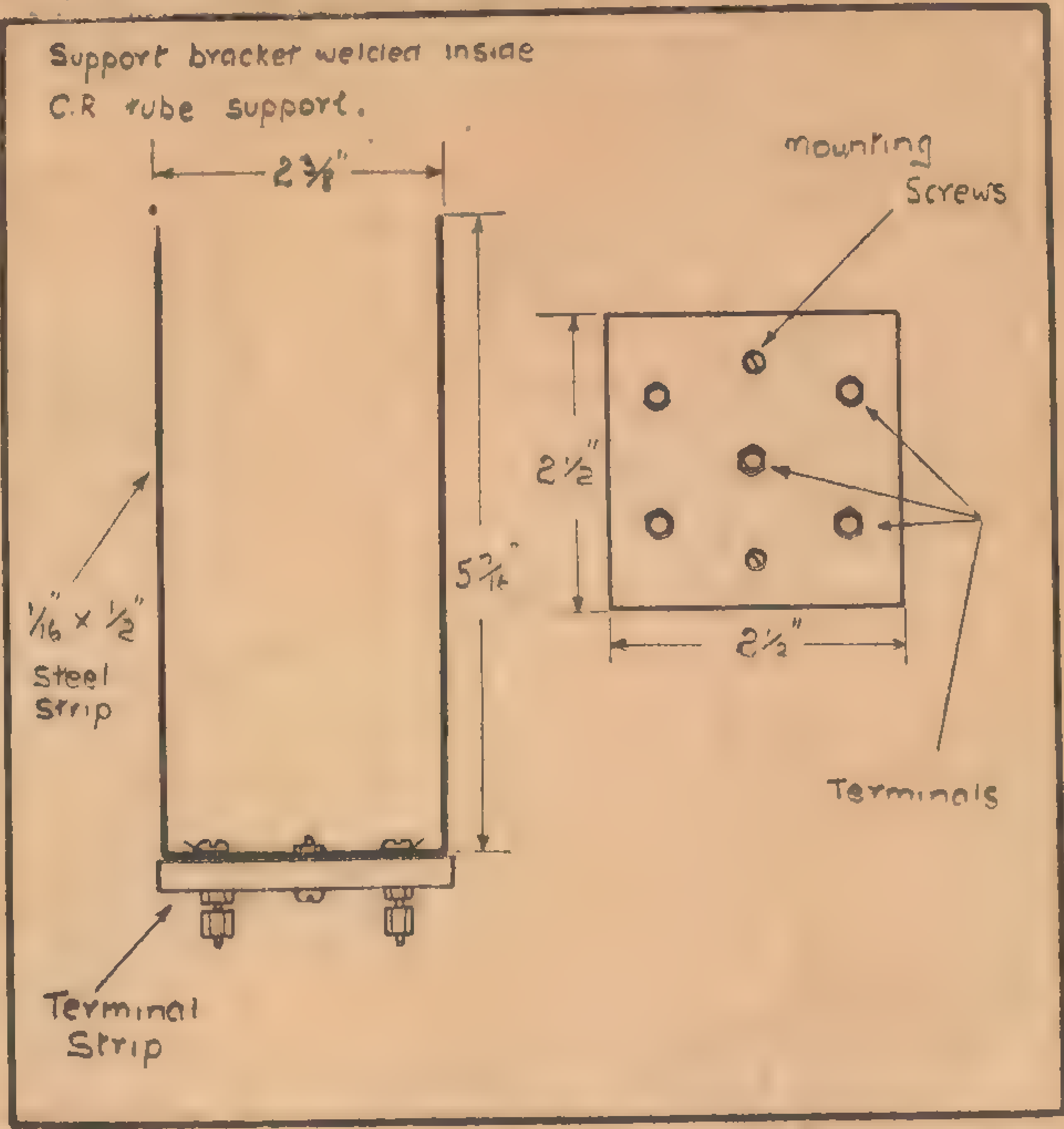
The focus control is wired so that the second grid becomes more positive as the control is advanced in a clock- wise direction. This control and the intensity control have to be adjusted simultaneouly, to obtain the best re- sults. This is no serious disadvantage and you will get used to it very quickly.

The shift controls will not necessarily locate the spot in the centre of the screen, when the pointers are set in a vertical position with the moving con- tact just half-way along the carbon track inside of the control. They may have to be set somewhere varying be- tween one-quarter to three-quarters of the full turn. This is undesirable, but one soon becomes accustomed to it.

As linear controls are unobtainable in the carbon type and wire wound units

DEFLECTOR PLATE TERMINAL PANEL

Figure 8. Although not an essential feature, it is often handy to have a means of obtaining access directly to the deflector plates. For this purpose, a small terminal panel may be mounted on a bracket welded or bolted to the rear of the CR tube support. A suitable hole in the case gives access to the terminals. In ordinary usage, the two pairs of terminals are bridged with short lengths of wire. The position for the terminals is shown in the schematic circuit diagram.



are only manufactured up to 25,000 ohms, there is very little choice if one cannot get hold of some mixer con- trols as we did.

To use 25,000 ohm controls, the whole voltage divider network would have to be re-calculated due to the need for high current drain. The voltage of 330 volts would cause a current drain of 13 ma, which is much more than our component parts are designed to stand up to. The dissipation of these con- trols would also exceed the maximum for which they are designed.

SPOT SHIFT CONTROLS

The shift controls are wired so that the left or vertical shift lowers the luminescent point, when turning in a clockwise direction, and the horizontal shift, by turning the same way, guides the spot from left to right.

The gain controls are standard 1.0 meg controls, but 0.5 meg would do A calibration in decibels or in hun- dredths of volts for a given deflection is useful but not essential.

It is an excellent scheme to put a celluloid disc in front of the CR tube itself, with lines engraved in distances of ¼in. or so, similar to Fig. 6 in our last issue. This helps greatly in main- taining a means of comparison for dif- ferent phenomena on the screen.

SWEEP OSCILLATOR

The middle part of the front panel is given to the controls for the sweep generator. The synchronisation con- trol, R11, is wired similar to the gain controls for the deflection amplifiers Turning it clockwise increases the amount of synchronising voltage fed to the grid of the gaseous tube.

It is important to use this control carefully. Too much synchronising voltage will distort the picture on the screen considerably. For low frequen- cies it is generally unnecessary to use this control at all, as it is quite suffi- cient to adjust the fine-sweep control until the picture on the screen appears stationary. As a matter of fact, it is often helpful, unless some quantitative values are taken, to keep the picture moving at a very slow rate.

The intensity can safely be set much higher while the curve does not re- main on the same place all the time. If the image is stationary, the lumines- cent spot always appears on the same very small portion of the screen sur- face, thus causing this line to be "burnt in." This may damage the tube tem- porarily if it only lasts for a compara- tively short time. Under certain cir- cumstances it can spoil the tube alto- gether.

INTENSITY SHOULD BE KEPT LOW

It is advisable to reduce the bright- ness of the trace as far as possible and also to increase the bias immediately the observation is complete. By this means, the life of the CR tube can be prolonged considerably.

It is a good scheme also to use the instrument with a small piece of card- board as a screen around the tube. This allows one to decrease the in- tensity considerably without impairing the clarity of the image.

Now back again to the synchronisa- tion control. The control is especially useful at higher frequencies. All one has to do, as soon as some pattern is obtained, is to increase the synchro- nising voltage until the picture appears to stand still. As mentioned earlier, it is very wise to reduce the synchronis- ing voltage as much as possible, keep- ing the picture steady with the fine- sweep adjustment.

(Continued on Next Page)

Figure 9. Another view of the chassis. This gives an excellent idea of the rear of the panel. Note particularly the U-shaped support for the base of the C.R. tube. The leads run up the inside of this support through a hole in the chassis.

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Below this control (R11) we find R15. This is the fine adjustment for the horizontal sweep. This control is used as a simple rheostat. Unfortunately, this control cannot be seen very clearly in the photos, as it is hidden behind valves or other parts.

Use was made of a logarithmic 1.0 meg potentiometer. Here, again, the logarithmic curve is not of advantage, but, as no other controls are available, it must serve the purpose. The disadvantage lies in the fact that the control is very insensitive in the first quarter, becoming increasingly critical towards the end.

The control is wired in the circuit in such fashion as to decrease its resistance when turned in a clockwise direction. This means that the frequency becomes higher the further the control is advanced. As the switch, which is mounted below the fine adjustment control works in the same direction, this is the logical way.

The switch is a 12 by 1 standard yaxley switch, with a stop soldered in after the eighth position. We actually did not bother to put in any stop, just neglecting the other four positions. If any other frequencies should be required these positions are readily utilised.

SEMI-ROTARY SWITCHES

We come now to the semi-rotary switches. The one on the left changes the synchronisation from internal to external. It seems, at first glance, apparently absurd to synchronise the sweep to any other frequency but the one which is under observation. But the reason will be given in our next issue when we intend to describe some of the most important applications of the unit.

For the external synchronisation voltage, the top right hand terminal has to be used. C25 isolates the grid of the tube against d-c voltages which may be present on this terminal. In the other position C8 brings the synchronisation voltage from the plate of the vertical deflection amplifier to the grid of the discharge tube.

The components C8 and R11 form a phase shifting network, and the phase on the grid will be different from th[e] on the plate. The sine wave is ma[de] to appear from node to node inste[ad] of from anti-node to anti-node, whi[ch] would be expected according to t[he] theory of synchronisation, as stated [in] our last article. This is certainly mu[ch] nicer than would be the case if th[e] picture appeared from anti-node [to] anti-node.

RIGHT-HAND SWITCH

The second semi-rotary switch dis[connects] the grid of the horizont[al] amplifier from the built-in sweep-gen[erator] and throws it to the middle ter[minal] on the right-hand side of th[e] front plate.

By this means it is possible to appl[y] any desired voltage on the horizonta[l] plates. As we shall show in the nex[t] article, this permits the instrument t[o] be used for a particular method of as[sessing] the distortion in an amplifier.

This just about concludes the description of the two-inch cathode-ray oscillograph. By this, the reader should have a fairly clear understanding o[f] its operation. As far as the general layout of the chassis is concerned, we do not think any real improvement could be made. However, we are quite aware that the wiring of the original model is by no means perfect.

A FEW HINTS

As pointed out earlier, this instrument is not intended for the beginner who just takes his first steps into the radio field. The advanced enthusiast who starts constructing such an instrument will not be likely to follow us in the placing of every resistor and capacitor. As soon as he only gets the "hang" of the job he will build it up to suit his own ideas.

For these constructors we give one or two hints. Avoid internal coupling between the circuits as much as you

...n. Do not twist the leads to the ...eflection plates together. Small ...pacities can distort the picture con...derably if they appear between the ...ates.

Also keep stray-capacities to earth as ...w as possible. The impedance of ...ost of the circuits is fairly high. ...apacity to earth usually means at...nuation of the high frequencies.

In the case of some adjustable cir...uits, the frequency response charac...ristics of the circuit change every ...me the particular control is varied.

...O SHIELDED WIRE!

Do not use shielded wire. The fre...uency range of the instrument is from ...0 to 300,000 cycles per second.

A capacity of 50 mmf, which has an ...mpedance of several hundred megohms ...t 10 cycles, only offers an impedance ...f about 10,000 ohms at 300 kc. Any ...ength of shielded wire will have a ...uch higher capacity than the figure ...mentioned.

Be careful to insulate carefully the ...eater wiring and the grid wiring of ...he 902. The "fly-back" blackout re...sistor should be connected as near as possible to the grid pin.

Another point to watch is that all resistors should be of ample size to dissipate the power without developing any appreciable heat. Where there is too much heat there is nearly always a variation in rated value. In a delicate arrangement like the sweep-generator, such changes would cause changes in frequency. Therefore, frequency stability will suffer, the more heat is present inside the chassis. Even so, it is good practice always to switch on the oscillograph two or three minutes before starting to use it.

WITH THREE-INCH TUBE

As promised in our last issue, we want to give a few hints as to how to convert this unit, without much extra cost, into a 3-inch job.

Obviously, there must be a 3 1-16in. hole in the front instead of the 2 1-16in. in this job. Furthermore, the 906 tube is considerably longer (11¾in.), which is just the right length to fit the same size chassis. The transformer and choke have to be shifted forward about two inches and the support for the tube goes back behind the transformer and choke.

There is no longer room for the two rectifier valves where they were before, so they have to be shifted back behind the transformer as well. The author is, at the moment, working on one of the bigger models and, if it is finished before the next number goes to press, a photo will be included.

The voltage suggested for anode number 2 is about 800 volts, this being about the limit with which a type 80 rectifier can be expected to operate. For higher voltages a 2X2/879 would have to be used.

The transformer—only a specially designed type will work here—would have to have the following windings: Apart from the usual primary winding there are five filament windings; 5V 2A, 6.3V 2A, 2.5V 1A, these for the ordinary deflecting amplifier section. 2.5V 2.5A and 5V 2A, shielded and well insulated, for the 906 tube. The high voltage winding is similar to the transformer mentioned in our last issue, in two sections, a centre tapped 375 volt 15mA section, extended on one side to 580 volts.

VOLTAGE DIVIDER

The voltage divider network needs some adjustment, too. The top part remains unaltered, but the bottom part (Fig. 4) must be adjusted to provide voltages for the 906. We may find room for more details at a later date. So much for conversion to a three-inch tube.

Over the whole unit fits a cover, which can clearly be seen in our photographs. On the sides are a number of louvres for ventilation, and one hole is provided on the back to take the mains cord. Three-wire flex preferable, the third wire being earthed to the chassis.

Another hole in the back of the cover takes a plate which is shown in our last diagram. It is made of ⅛in. black bakelite and screwed to strips which fit on the vertical tube-support. The centre contact is earthed.

The top contacts are connected to the deflector plate pins on the CR tube socket. The wires, which are shown in our circuit diagram to go to the deflector plates, are wired in fact to the bottom contacts on this terminal plate.

Normally, there are two little clips or pieces of wire connecting the corresponding pairs. If one wants access to the plate directly, all you have to do is to disconnect the bridges and to connect one side of the input source to the deflection plate. The other wire is returned to the earth terminal in the middle of the terminal plate.

NEXT MONTH

Next month we hope to present the final article in this series dealing with the application of the cathode-ray oscillograph in testing receivers and amplifiers.

THE SERVICE-MAN WHO TELLS

By a Service Engineer of Radio Equipment Pty. Ltd.

Being some real-life stories of troubles which were experienced in a day's work. Maybe some day you will be worried by one of these problems. Read how this man solved them.

ONE of the most difficult complaints about radio reception to overcome is that of volume variation. At one instant a radio receiver may be reproducing signals at a satisfactory volume, and then, at the next instant, it may suddenly fade away to a whisper, or, perhaps, the volume may suddenly jump up to a very loud level.

NUMBER 1.

There are many possible causes for this. Quite frequently the fault is due to a defect in the electrical wiring of the building in which the receiver is housed. A poor joint in the electrical wiring or in the continuity of the metal conduit housing the electric wiring quite frequently accounts for variations in signal strength in the building.

The remedy in this case is to have a licensed electrician check over the wiring, although in many cases the trouble is obviated by the use of an efficient outdoor aerial and a good earth connection. The worst possible combination is a picture-rail aerial, no earth, and a receiver without AVC.

Even when the fault is confined to the receiver itself, there are a large number of components which can result in this type of trouble.

Any intermittent connection in a tubular condenser, which is used in the receiver as a plate, screen, cathode or AVC by-pass condenser, quite frequently produces this type of trouble. It sometimes occurs that, when straightening the leads to these tubular condensers before soldering them into the receiver, the leads are pulled slightly, resulting in bad connection between the end of the lead and the plates of the condenser itself.

The fault is, of course, inside the condenser casing, and is not visible. The result is that the condenser may be placed into the circuit and may give fairly good results at first, but after a time the defective connection between the wire and the plate may become intermittent, causing the condenser to be periodically inoperative.

SUBSTITUTION TESTS

Probably the most efficient way of determining this trouble is to wait until the volume of the receiver drops, and then to temporarily substitute a new condenser known to be in good order for the various ones in the receiver. It is simply necessary to hold the condenser in place for a few seconds to determine whether the volume returns to normal or not.

If the volume suddenly returns to normal, as soon as the condenser connected, then it is probable that condenser with which it is in para is defective.

When this fault exists in one of condensers employed in the AVC circ it will often be found that the trimm condenser tuning the coil, or IF tra former to which the AVC condenser connected, has no effect on the tun of the receiver.

AFFECTS ALIGNMENT

For example, if a defective condens is connected in the grid return circu and if the trimmer condenser of t coil or intermediate frequency tran former connected to the grid of the val is varied, then it will be found th altering the condenser has no effe whatsoever on the receiver's perform ance. This is one way of checking u on the condensers in the AVC circu when it is suspected that a faulty con denser is causing the volume variatio in a receiver.

Other very common causes for suc variations in signal strength from a re ceiver are a fault in a tube, a defectiv carbon resistor, a corroded point in a intermediate frequency transformer c coil, or a defect in the volume control.

All these parts should be carefull checked as thoroughly as possible whe volume variations are experienced.

NUMBER 2.

The majority of modern receivers ar provided with terminals at the rear o the chassis, to permit the use of a phonograph pick-up. In certain models the tonal quality is quite satisfactory on radio reception, but when a pick-up is connected the tone becomes badly distorted.

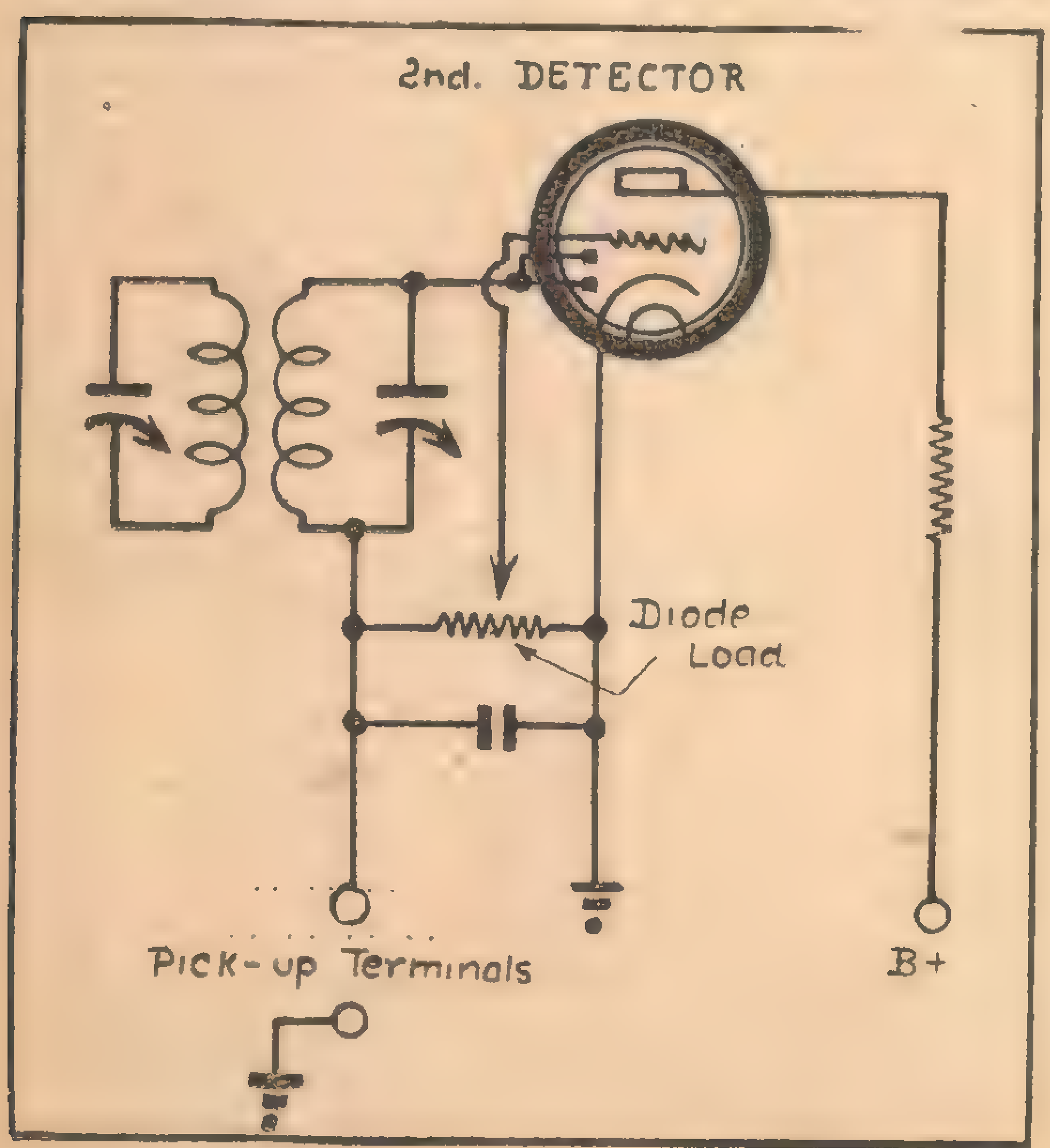
This fault can often be traced to the fact that the second detector tube is operated in what is known as a "diode-biased" circuit. This arrangement saved the cost of one or two resistors and condensers. The most commonly used "diode biased" circuit is shown in Fig. 1.

In the absence of an RF or IF signal, the tube works with no bias, because there is no resistance included in the cathode circuit to provide a voltage drop for the grid. When a signal voltage is received, the rectified signal current flowing between the diode plate and cathode returns to the transformer secondary through the diode load resistor.

BIAS DEVELOPED

As the current has been rectified to DC, and flows always from cathode to transformer, a negative voltage drop appears at the transformer end of the resistor, and this voltage is applied to the grid of the tube as negative grid bias.

Of course, with no signal voltage received, there will be no current flowing through the circuit, and no negative bias applied to the grid. When a gramo-



A typical diode-biassed detector of the type often found in receivers manufactured about 1935. The circuit was most frequently applied to the 55 or the 85. The incoming signal caused a flow of current in the diode circuit, developing a negative bias, which was applied to the control grid of the valve.

ne pick-up is connected, no bias is vided, and therefore the grid of the e and also the diode plate will draw rent during the positive half-cycle of h alternating cycle provided by the mophone pick-up.

he results of this grid and diode te current flowing on the positive f-cycles is that these half-cycles are uced considerably in strength comed with the negative half-cycles, and ere harmonic distortion occurs.

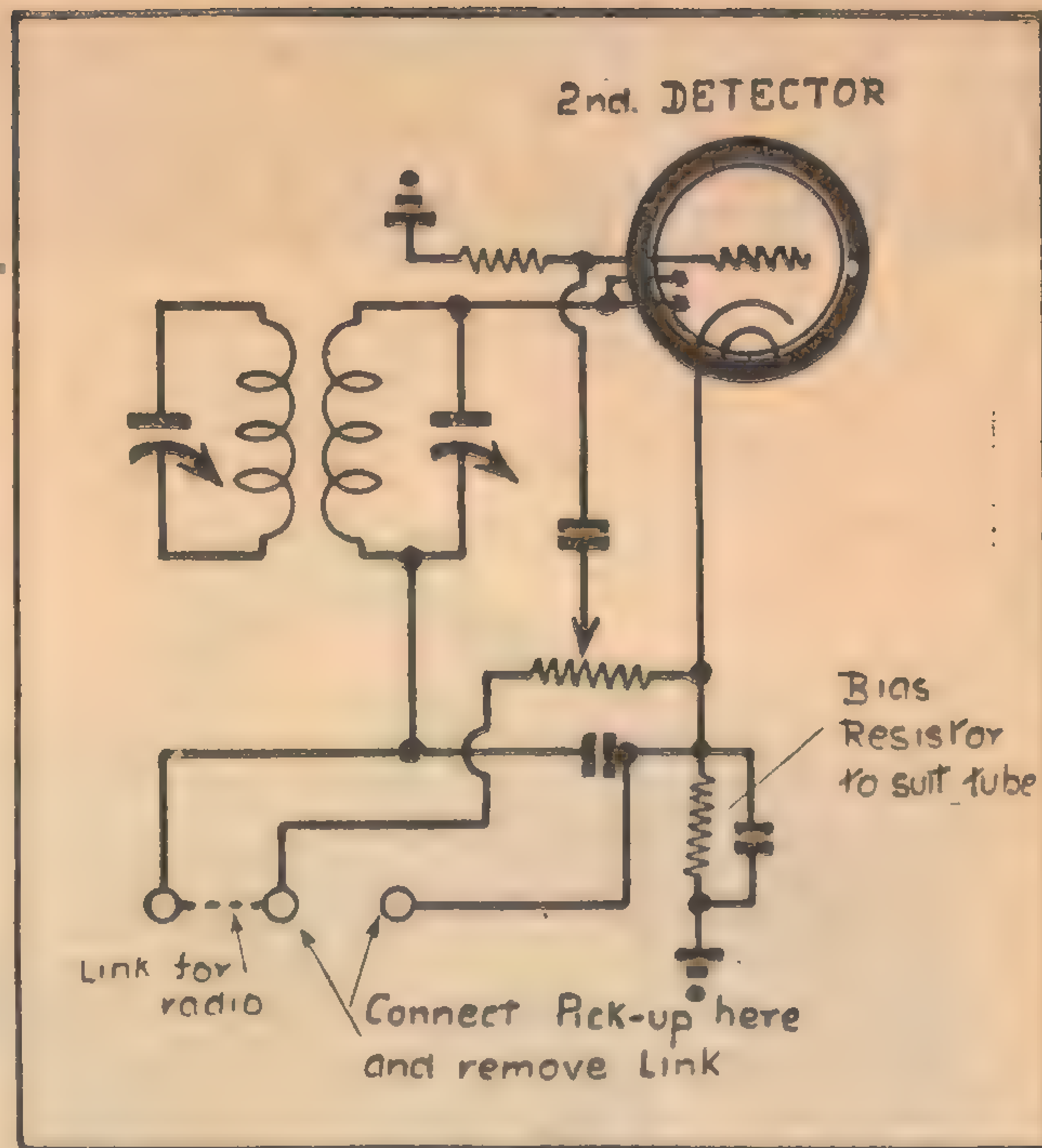
DEPENDENT BIAS

The remedy, in this case, lies in proing a source of negative grid bias for e grid of the tube, independent of at provided by radio frequency or ermediate frequency signals. The cirit diagram of Fig. 1 can be easily ered, as shown in Fig. 2, by the insion of two additional resistors and o condensers, so that negative grid s for the tube is provided by means voltage drop caused by the tube's ate current flowing through the retor in the cathode circuit.

During the reception of broadcasting ations, the signal current is confined lely to the diode circuit and flows from e diode plate to cathode, thence rough the diode load resistor back to e transformer. The varying voltage ops produced here are not applied to e control grid of the tube, which reives its bias through the grid leak and e cathode bias resistor arrangement.

★

A diode-biassed audio amplifier has the serious disadvantage that, when switched for gramophone amplification, there is no bias on the control grid and severe distortion results. The trouble can be overcome quite cheaply by rearranging the circuit, as shown, so that the amplifier is provided with the optimum value of bias, irrespective of the current flow in the diode circuit. The change may also effect an improvement in the performance on radio reception.



ANSWERS TO MATH'S. QUESTIONS

Here are the answers to the problems on Page 17.

1. 2.5 watts.
2. 1.0 watt.
3. 12.5 watts, 5000 ohms, 10 volts.
4. 0.5 watts, 500 volts.
5. 0.5 watt, 5.0 milliamps.
6. 125 volts, .63 watts.
7. 300 ohms, 0.75 watt.

When it is desired to operate a gramophone pick-up, it is necessary to connect the pick-up to the receiver and provide either a switch to disconnect the diode circuit or, alternatively, to provide three terminals so that the diode can be isolated by means of removing a wire link from two and the pick-up connected to one of these and the remaining one.

The fixed negative bias obtained from the resistor in the cathode circuit ensures satisfactory tonal quality when the pick-up is used and, by isolating the diode circuit from the pick-up by means of the switch or terminals, no rectification of the pick-up signals can occur.

For radio reception, the negative bias derived from the cathode circuit is not a disadvantage, but usually provides a slight improvement in the receiver's performance.

NUMBER 3.

In carrying out the alignment of a dual wave receiver, difficulty is often experienced in obtaining satisfactory sensitivity over the whole of the short-wave band.

In the case of the broadcast band, the sensitivity can be adjusted at both ends by means of the trimmer condensers, which are effective at the high frequency end, and the padding condenser which is adjustable at the low frequency end. In practice, the tuned circuits are adjusted to resonate correctly at the high frequency end by means of adjustments to the trimming condensers, which are connected in parallel with the tuning condenser gang or with the individual coils.

After this adjustment had been carried out, the receiver is tuned to a low frequency, and the adjustable padding condenser varied until the circuits track properly at this end of the band also. If the coils have been designed carefully, then the adjustment at both ends of the band means that the sensitivity of the receiver should not vary greatly over the whole of the broadcast range.

In the case of the short-wave band, it is customary to provide only adjustable trimming condensers and to employ a fixed value of capacity for a padding condenser. In aligning the short-wave bands, it is thus possible only to make an adjustment at the high frequency end by means of adjusting the trimming condensers in parallel with the coil.

Usually a fixed capacity of .004 mfd. proves satisfactory as the padding condenser for short-wave coils covering the band from 16 to 50 metres, or a capacity of .005 mfd. is used for covering the band from 13 to 42 metres.

In some receivers, depending upon the coil design and wiring, these values of capacity are not really correct to enable the circuit to track properly at the low frequency end. If difficulty is experienced in obtaining suitable sensitivity at the low frequency end, it is advisable to experiment with different sized condensers ranging from about .001 to .006 or .008 mfd., and to select the size which gives the greatest sensitivity.

By first adjusting the trimmers for correct alignment at the high frequency end of the short-wave band, and then adjusting the size of the padding condenser for greatest sensitivity at the low frequency end, it may be found that the sensitivity is made even over the whole of the band.

READJUST TRIMMERS

After any alteration has been made to the capacity of the padding condenser, it will probably be found necessary to make a slight readjustment to the trimmer condensers at the high frequency end of the band again, because any change in padder capacity has a slight effect on the tuning of the circuits at the high frequency end of the band.

The new value of padder may have an effect on the dial tracking at the low frequency end of the band, but this may be tolerated if the change effects a marked improvement in the performance.

DO YOU KNOW—ABOUT ELECTRIC MOTORS

(Continued from Page 33.)

CONSTANT SPEED

The advantage of a shunt wound motor is the fact that it tends to run at a fairly steady speed. When the motor starts off, it consumes a very large amount of current from the power mains, and this amount of current decreases until it reaches its normal operating speed. The current then is very small if the motor is running unloaded

Applying a load to the motor has the effect of slowing its speed down slightly, but the main effect is that it simply causes it to consume more current from the power mains, and this extra current tends to keep the motor running at a reasonably constant speed.

Due to the fact that shunt wound motors maintain an even speed, it is quite safe to operate a motor without any load. The motor will only speed up to a certain limit and then will continue to rotate at this speed.

(To Be Continued Next Month)

TRADE NOTES AND NEW RELEASES

A.W.A. MODULATED OSCILLATOR Type J6726

The AWA Modulated Oscillator, model J, 6726, has been designed with a view to the requirements of radio Servicemen and of others whose work may not necessitate an elaborate and expensive standard signal generator.

THIS new A.W.A. modulated oscillator will deliver modulated or unmodulated signals at any frequency between 150 Kc/s and 30 Mc/s. With it a variety of tests may be carried out, including the following:

1. Alignment of IF and RF circuits at any desired frequency.

2. Adjustment of receivers provided with wavelengths or kcs scales to correct dial calibration by setting trimmers and padding condenser.

3. Examination of ganged TRF circuits for errors in tracking.

4. Measurement of overall sensitivity of all types of receivers at any frequency and gain of IF amplifiers.

5. Estimation of noise level at higher sensitivities by comparison of audio outputs between modulated and unmodulated carrier of equal strength.

6. Determination of stage gain in IF or RF amplifiers.

7. Testing of valves for performance under working conditions by insertion of several in succession in a given socket in a receiver and noting the change in stage gain or overall sensitivity.

8. Checking the performance of AVC in receivers.

9. Measurement of selectivity of IF or RF amplifiers in terms of band width in kcs for input signals one hundred or one thousand times larger than the signal or tune required to give so chosen value of audio output.

10. Determination of image ratio, the ratio of the microvolt input at image or second spot frequency to microvolts at the wanted signal fr quency, both giving equal audio outp

This list of tests actually covers m than is usually required in receiver s vicing. None of these tests require instrument with capabilities of accura available in a signal generator. Co sequently the controls and methods calibration can be modified in the dir tion of speeding up and generally si plifying operation. This object has be achieved in the type J.6726 modulat oscillator, with but small reduction accuracy below average signal genera performance.

The specifications are as follow:

FREQUENCY RANGE

150 kcs to 30,000 kcs in six range selected by a switch.

Range A 140 kc to 350 kc.
„ B 340 kc to 850 kc.
„ C 840 kc to 2100 kc.
„ D 58 metres to 145 metres (2070 kc to 5170 kc.)
„ E 24 metres to 60 metres (5000 kc to 12,500 kc.)
„ F 10 metres to 25 metres (12,000 kc to 30,000 kc

All ranges are directly calibrated o a large, easily-read precision type di with rapid and vernier movement, th ratio of vernier being 56 to 1. Range A, B and C are marked in kcs, an D, E and F in metres.

Calibration accuracy is better than per cent. on range C, and within 2 pe cent. on the other ranges.

OUTPUT

The output is variable from 1 micro volt to 300 millivolts. Leakage through the attenuator can only be detected o range F.

(Continued on Next Page)

AUSTRALIAN RADIO COLLEGE BUSY
Effect of War Conditions

MR. L. B. GRAHAM, principal of the Australian Radio College, reports that the war has brought about a greatly increased demand for radio training.

Since the outstanding requirement of a modern army is mechanical mobility, it follows naturally that technical men of all descriptions are required in great numbers.

Because it is necessary at all times to have rapid communication, many thousands of men with radio knowledge are urgently required, and are being absorbed into technical branches of all the fighting forces.

As a result of the great demand for trained men, the Australian Radio College is extremely busy with training matters these days. An exceptional number of men are taking up ARC training for various branches of the fighting forces in addition to many others who are entering the radio industry itself.

The Australian Radio College provides correspondence courses and night classes and is equipped to give thorough practical as well as theoretical training. Those interested are invited to write for full particulars to Mr. L. B. Graham, ES and A Bank Buildings, cnr. Broadway and City-road, Sydney. The phone numbers are M6391 and M6392.

THE T.R.F. QUALITY SIX RECEIVER

(Continued from Page 31)

Vhen the receiver was first tuned to station, the impression was that all sibilant sounds in speech were un-ly emphasised. After a few minutes s impression no longer remained.

Apparently, one becomes so used to aring speech reproduced in the nor-l fashion, that it is strange at first hear the sibilant sounds issuing from oud speaker. If you have any doubts this point, listen to someone talking d take particular note of the sibilants d the sounds of breathing. Then ten to your radio and note the absence the same sounds.

GH FREQUENCY RESPONSE

Provided the hum level and back-ound noise are very low, the effect of is improved response on speech is to nd an air of intimacy, which can obably be best described by the term resence."

On musical programmes, the differ-nce is also very apparent, particularly n non-recorded items. With record-ngs, the difference in the reproduction ay or may not be apparent, depending n the quality of the recording.

Some listeners will take naturally to e sustained treble response. Others, fter years of listening to "mellow" one, may find it a little difficult to ppreciate at first.

One point, which must be particularly tressed, is the necessity for mounting he speaker in a position where it will e able to reproduce the bass to the est advantage. If the sustained treble esponse is not supported by good bass he reproduction will sound very thin ndeed. The speaker itself should have natural cone resonance at as low a requency as practicable.

As we mentioned earlier, the full treble esponse can only be used to best ad-vantage in the absence of natural or man-made hash. If there is too much background noise, you will be compelled o do something to restrict the response in the upper register.

TONE CONTROL

This is where the tone control comes in very handy. When it is turned to the treble attenuation position, the background noise is cut down considerably.

The tone control can also be used to cut the 10 kc/s whistle which is heard on some of the stations. The whistle is the result of a heterodyne of the desired signal by another separated from it by 10 kc/s. The whistle is not always heard and it depends on the relative strengths of the two signals.

Space does not permit a lengthy discussion as regards the construction of the receiver, but you should have no difficulty in getting the receiver into operation.

The outstanding points have been mentioned in order. For the rest, it is only necessary to follow more or less standard practice, giving due consideration to the various constructional hints which have been mentioned again and again in the various constructional articles.

The alignment is very simple. Tune the receiver to a station in the vicinity of 2SM and peak the trimmers as best you can. The AVC action may make this rather difficult and it is desirable, in the event of suitable instruments not being available, to put a large cathode bias resistor in the cathode circuit of the r-f amplifier valves to reduce the sensitivity.

Alternatively, you could leave the job till all the local stations have closed down and peak the trimmers on some distant station at the high frequency end of the band.

Adjust the two r-f trimmers for maximum volume, rocking the dial slightly, if necessary. Now swing the dial to the low frequency end of the band and adjust the dial pointer so that the stations at that end of the dial come in at the right positions.

Leaving the pointer set, the trimmers can now be readjusted so that the stations at the high frequency end come in at the right places. All the trimmers should be adjusted and the ultimate condition should be such that the station is heard at the right position and any movement of any of the trimmers results in reduced volume.

If the dial, coils and gang match up, the stations in the centre of the dial should fall in the correct place.

AIRCRAFT ARE THE EYES OF THE ARMY

(Continued from Page 7.)

Ask yourself which would cause more damage to a battalion of tanks—one army bomber or thirty light planes, each dropping say four 50lb bombs? Consider the effect on an infantry regiment, in a truck convoy, on the march or deployed in a field, if a hundred or even fifty light planes suddenly flew over them low down and dropped 12lb fragmentation bombs.

ARMY PILOTS

What of the pilots for these light planes? They need not—and should not—be Air Corps pilots, trained at a cost of several hundred pounds each to fly fast, heavy and expensive equipment.

They should be Army men, non-commissioned officers, thoroughly familiar with the Army and its needs, and with enough air experience to take up a light plane, do a job with it and land it again.

Fifty hours' solo air time is ample to train a soldier to fly light planes and to perform military tasks such as those outlined. How many hours solo did young pilots have in the Royal Flying Corps, late the RAF, in World War 1?

RAPID TRAINING

Many went into operational squadrons in France, during 1916 and '17, with 25, 30 or 40 hours. They didn't feel that they were being pushed into the war untrained, nor were they.

Why? Well, those old craft were really large light planes, with relatively small engines. A night-flying FE with a 50ft wing-span and a 165 hp engine, had practically the flying characteristics of a Cub. Heavier, of course, but not nearly so fast. The top speed was 75 mph.

Now, if the lads of 1917 could fly those over-sized light planes and go to France and fight in them after 25 or 30 hours' solo, what ground is there for believing that today's crop of youngsters can't do as well, or even better, in much better and easier-to-fly equipment?

In short, if the infantry wants to have its own planes, flown by its own soldiers, there's no aeronautical reason why they shouldn't have them.

ANOTHER ASPECT

There is another aspect of the light plane that is of particular interest. Under the suggested programme for the Civil Air Defence Services of America, the accumulated knowledge and experience of the great civil pilot pool will be organised for defence.

There is no point here in discussing the programme in detail, and its only place here is by way of explanation of the vital use to which America's civilian pilots and their planes—of which light planes form the vast majority—can be put in the national defence.

(Continued on Page 64)

A.W.A. MODULATED OSCILLATOR

(Continued from previous page.)

The approximate output signal on the other ranges may be estimated from the following table.

Range		Multiplying factor for Attenuator Calibration
A	..	1.4 microvolts
B	..	1 „
C	..	1 „
D	..	0.5 „
E	..	0.2 „
F	..	0.08 „

EQUIPMENT

Two type 1Q5GT Radiotron valves are used—one as RF oscillator and one as 400 cycle audio oscillator.

One 1.5-volt PR8 battery—1 45-volt light duty battery.

DIMENSIONS OF CARRYING CASE

Depth	8in.
Width	12in.
Height	8in.
Weight	21lb.

THE MONTH ON SHORT WAVES

by Ray Simpso

HIGH FREQUENCY STATIONS FADING AT NIGHT

DAYLIGHT RECEPTION IMPROVING

Stations on the higher frequencies are now weakening at night and in some locations those on the 13 metre band are already inaudible while those on 16 metres are also becoming fainter. This condition will continue for a few weeks and then they will disappear till next summer.

AS a compensation for the above conditions we now find the daylight hours very much better for reception and even around lunch time quite a few stations can be heard at reasonable strength.

LISTENERS will now have the equivalent of an extra hour's listening without having to stay up and consequently may find quite a number of new stations which they missed while Daylight Saving Time was in force. A difference will also be noticed in the mornings, of course, but altogether the first few weeks should prove quite interesting, bearing in mind of course that actual reception conditions are also changing.

Our friend Mr. Hallett brings to our notice a new session from the BBC, which we think should be of interest to quite a number of our listeners.

Every Tuesday night at 11.30 pm in the London Calling programme (this is actually a fortnightly item, so it is really every second Tuesday), a short technical radio session is broadcast which though actually intended for beginners, may quite often give the answer to some little problem which listeners may have encountered.

Our Russian Allies are now giving a news service in English from Kuibishev at 11.15 pm, using 6115kc. 49.08m., and in the mornings at 7 am there is another news service from the same station, when they transmit in the 19, 25, and 49 metre bands. These broadcasts come in at quite good strength.

SHORT-WAVE CLUB

FROM time to time quite a numb of our listeners have suggested form a Short Wave Club along t lines of those established in the Unit States. As we have stated previously these columns, we do not think a additional Australian clubs would justified at the present time, as rea ers who wish to belong to a club a already amply catered for by tho already in existence.

One of the largest listeners' club the All Wave All World, which is con ducted by our Sydney contempora and has a membership of several hun dreds. Many of our readers belong this organisation, and have thereb gained correspondents all over Austra lia, and also in overseas countries.

As these will be the last notes by th present writer for some time, he woul like to express his appreciation of th friendly collaboration which has exist ed between the Sydney magazines i relation to their short-wave news. Le us hope that when the war is over w can arrange a joint gathering on th lines of that held a couple of year ago, when we had the pleasure of en tertaining our contemporary short wave editor, Mr. L. J. Keast, who at on time was a regular contributor t "Radio and Hobbies."

RAY SIMPSON JOINS R.A.A.F.

Ted Whiting Takes Over S.W. Pages

Mr. Ray Simpson, who has been the short-wave contributor to Radio and Hobbies since its inception, has now joined the RAAF.

EVER since the very first issue of "Radio and Hobbies," the Short-Wave pages have been compiled month by month by Mr. Ray Simpson. Aided by a keen band of short-wave correspondents, he has built up a reputation for accuracy and, time and time again, he has been able to make the claim "first with the news."

However, Mr. Simpson has now joined the RAAF, and his connection with "Radio and Hobbies" is necessarily severed for the duration. While we regret to lose the services of this esteemed contributor, we are glad to see him take his place in the armed forces.

"Radio and Hobbies" has been fortunate in securing the services of Mr. Ted Whiting, a well-known Sydney listener. Mr. Whiting will compile these pages as from the June issue. In fact, he has prepared a goodly amount of the material in this issue.

PLEASE note that all Short-wave reports should now be forwarded to Mr. Ted Whiting, 16 Louden-street, Five Dock, NSW. He will either answer direct or through "Answers To Correspondents Column" as circumstances dictate.

Mr. Ted Whiting, who has taken over the job of compiling these pages.

Mr. Whiting plans to carry on the section in exactly the same way as Mr. Simpson has done. Short-wave listeners are therefore requested to forward the usual reports to Mr. Whiting at 16 Louden-steet, Five Dock, NSW.

WHEN AND WHERE TO LISTEN

Here is a chart for quick reference, giving the call and listening times for the best short-wave stations on the air. Where the station is not receivable at good strength when it comes on the air, the time is given at which reception should be satisfactory.

6 AM TILL NOON

dio Cairo, 50.17m. Quite good till closing at 6.30 am.
RR, 49.38m, Daventry. Good signal till nearly 7 am.
X, 48.86m, Berlin. Quite good till just after 6 am.
O3, 31.14m, Rome. Very loud till about 7 am.
RUW, 30.93m, Boston. Quite loud till about 8 am.
O4, 25.4m, Rome. Loud till after 7 am.
LWO, 25.62m, Cincinatti. Good till after 9 am.
GEA, 19.57m, Schenectady. Holds up well till after 8.30 am.
st reception period from 6 am till 9 am.

Please send reports for the next issue to reach us not later than Monday, May 11, 1942.

NOON TILL 6 PM

XEWW, 31.57m, Mexico City. Very good till about 4 pm.
GSB, 31.55m, Daventry. Very good from 4.10 pm.
2RO3, 31.14m, Rome. Very loud station at 3 pm.
WRCA, 31.02m, New York. Also good station till 4 pm.
VLW3, 25.36m, Perth. Quite good all afternoon.
COCY, 25.55m, Havana. Loud signal till 4.15 pm.
HVJ, 25.55m, Vatican City. Some days is excellent at 5 pm.
XGOX, 19.74m, Chungking. Fair some days at noon.
VUD3, 19.62m, Delhi. Fair strength at 4.30 pm.
Best reception period from 3 pm till 6 pm.

6 PM TILL MIDNIGHT

KZRF, 48.86m, Manila. Fairly good from about 8 pm.
XGAP, 49.18m, Peiping. Very loud from 11 pm.
HJCX, 49.84m, Bogota. Quite good from opening 10 pm.
KGEI,, 41.38m, San Francisco. Excellent at 10 pm.
KET, 31.65m, Bolinas. Also very good at 10 pm.
CBFY, 25.54m, Montreal. Good from opening at 9.30 pm.
Saigon, 25.47m. Excellent strength from opening.
DJP, 25.3m, Berlin. Excellent strength at 9 pm.
DJR, 19.56m, Berlin. Excellent strength at 10 pm.
GSV, 16.84m, Daventry. Still good signal at 10 pm.
Best reception period from 7 pm till midnight.

NEW STATIONS OF THE MONTH

Canada—Australia—Newfoundland—Spain

WITH the return to Standard Time in Australia we now find conditions changed again slightly, and a further opportunity to log new stations is thus presented. At time of writing the new ones identified are not very numerous, but those heard have been particularly interesting.

VONH, NEWFOUNDLAND

For some months now we have heard a station on 5970kc. 50.25m., from around 11.30 pm, with typical dance music and announcements in English, but try as we could, no definite call or location could be understood. On some nights a news service could be heard, so we took down as many items as possible and forwarded a report to VONH, in St. John's, Newfoundland, as this was the only English-speaking station on this frequency.

We are now very pleased to know that our guess was correct, as verification card, accompanied by a very nice letter from the general manager of the Broadcasting Corporation of Newfoundland, has just arrived. With the present improved reception conditions on this band, VONH can now be heard quite often opening at 10.30 pm. Tune for this interesting station just slightly lower in wavelength than XGOY.

CBRX, VANCOUVER

Readers will remember that in the March issue we gave details of a new Canadian station, which was to open shortly in the 49-metre band, namely, CBRX, Vancouver, and said that reception should be possible in this country, provided operating times were suitable. Our forecast was correct, as we have now heard this new one at quite good strength, operating on 6160kc., 48.7m. Station comes on the air at 12.30 am, and plays light music till 12.45 am, gives a religious service from then until 1 am, and then begins the news service from the CBC news room.

Each quarter-hour announcement is made as follows:—"This is the Canadian Broadcasting Corporation, station CBR and short wave CBRX, Vancouver, British Columbia." This newcomer can still be heard at 1.45 am, but by that time it is beginning to fade out.

While dealing with Canadian stations, we remind listeners that the other Canadian Broadcasting Corporation station in Montreal, CBFY, has recently changed its frequency, and is now being heard on 11,745kc. 25.54m., instead of on 11,705kc. 25.63m. The change is not particularly good, as it is now jammed in between COCY and GSD, both of whom are coming in very well at night. However, the news service at 10 pm can easily be followed, and some very up-to-the-minute items are often heard.

VLQ4, AUSTRALIA

On Sunday, March 22, the Australian authorities opened up another station for the service to North America, and it operates on 7220kc. 41.55m., under the call sign of VLQ4. This station comes on the air at 12.25 am, and remains on the air until 1.10 am, strength being excellent all the time.

The choice of call letters is rather confusing, as we have already had a VLQ4 a long time ago, the frequency at that time being 17,840kc. 16.82m.

Quite a number of other Sydney Sydney telephone stations have been heard relaying programmes to the United States, these being mostly news commentaries by American journalists.

SPANIARD ON 25.27m

For those listeners who care to get up early in the morning, an exceptionally loud Spanish station can now be heard on 11,870kc. 25.27m. From 2.30 am, it can be heard giving a news service in Spanish, and then closes abruptly with announcement, "La Voz de Espagna de Santander," at 2.45 am. At 2.55 am it returns to the air and begins a news bulletin in Italian, which concludes at about 3.10 am. No music has been heard from this station, and the above is the only transmission we have heard from it on this frequency, though in the mornings around 7 am, there is one on the 42 metre band which is very like it.

OAX5C—PERU

THE well-known Peru station, OAX5C, located in Ica, has shown a big improvement during the past few weeks, and comes in very well on a Sunday afternoon on its new frequency of 9540 kc. It usually leaves the air shortly after 4 pm, but we have heard it till as late as 5 pm on some days.

With Our S.W. Reporters

MR. R. HALLETT

ANOTHER of our NSW reporters, who has been a keen listener for many years, is Mr. R. Hallett, of Burwood, who first began his listening with a modest 3-valve receiver in 1931. The next was a 5-valve AC model, and at the present time he uses a "Wireless Weekly" World Standard 6-valve set, covering the short wave bands from 18 to 55 metres.

INVERTED L AERIAL

After having experimented with various types of aerials, and also using an aerial booster, this reader has come to the conclusion that the inverted L aerial gives all round best results, both on the broadcast and short wave bands. The one in use at present is 32 feet high, 60 feet long, with a lead in of 40 feet, the direction being north-east by south-west. A doublet aerial in use previously was found to improve signals on the 75 metre band at the expense of stations in the 41 and 49 metre channels, which, of course, is no real advantage.

HEARD 70 COUNTRIES

In 1938 Mr. Hallett began writing to overseas short wave stations to obtain their verifications, and up to the present time has received 80 in reply from 70 different countries. In addition to these sw verifications, he also has 40 verifications from broadcast band stations in 20 different countries, which is indeed a very good effort, as these stations are much more difficult to receive.

A regular reader of "Radio and Hobbies" since the first number, and a keen follower of the short wave notes, he has contributed to many Australian and New Zealand magazines, and is also a member of the All Wave All World DX Club, Australian DX Radio Club, and the New Zealand DX Club, so readers will understand how enthusiastic he is.

THIS MONTH'S VERIFICATIONS

PSF.—14,690kc. 20.42m., Rio de Janeiro, Brazil. Another welcome card has just arrived from Brazil verifying our report of 14th June last. Their new card is very attractive, showing map of Brazil in blue with embossed call letters in centre, two flags in top right corner, and coat of arms top left. Quite an amount of other information is also printed on the card, which is signed by the Director of the Radio Division, Julio Barata. Address is The National Department of Propaganda, Radio Division, Rio de Janeiro, Brazil.

VUD3.—15,290kc., and **VUD4**, 9590kc., Delhi, India. These cards were also given up for lost, but luckily turned up recently, verifying our reports of as long ago as June, 1939. A very courteous letter accompanied the card, and also the latest schedule of the All India Radio stations. Unfortunately this list is not complete or correct at the present time.

VONH.—5970kc. 50.25m., St. John's, Newfoundland. As mentioned in our article this month, we have recently received our cerification for this interesting station. The card is the same as that for VONG, which we listed a few months ago, and is a very attractive one indeed.

FLASHES FROM EVERYWHERE

ANTIGUA.—Here is another new country to try for as there is now a shortwave station operating at St. John on a frequency of 7065kc. 42.46m. (same frequency as GRS). Station goes under the call of Radio Antigua, and gives news in French at 8 am, for the benefit of French nationals in the West Indies. English is used on Mondays, from 6 till 6.30 am (Globe Circler).

PARAGUAY.—As mentioned in last month's issue, there is a new shortwave station in this country, ZPA8, on 11,721kc., and we now have word of another, "Radio del Estado" (State Radio), which will operate on 6000 kc., with a power of 3.75kw. The location will be the capital, Asuncion.

USA.—The General Electric station, KGEI, is now authorised to operate on 11,730kc., 15,130kc., and 15,210kc., as well as its other channels used up till now. The Philadelphia station, WCAB, left the air for good on 31st December, 1941, so reports of hearing it since that date are obviously incorrect. We have not as yet heard the new West Coast station, KWID.

ICELAND.—There has always been a great deal of interest in the short wave station located at Reykjavik, and it seems to be the ambition of many listeners to add it to their log. It is now back on the air, still using original call letters, TFJ, on 12,235 kc. 24.52m. every Friday around 9.15 am, when it gives relays to the NBC (Globe Circler).

MEXICO.—In last month's Stop Press panel we mentioned a new Mexican on 31.39m., heard in the late afternoons. We have now identified it as XEFT, in Veracruz, and its frequency has changed slightly, now being 9550kc. 31.4m. It is still quite good till closing at 4.5 pm, with announcement in English, followed by a man singing a Spanish-type song.

"THE VOICE OF FREE INDIA"

New Indian On 26.09

ONE morning while tuning over 25-metre band we were surpri to hear a very strong signal on 11,50 26.09m., programme being a news b letin in English.

This station was first heard at am, and was followed till it clos down at 1.55 am. The most intere ing thing about it, however, was identity as every so often during news in English, the announcer s "This is the Voice of Free India." T was preceded by another sentence Hindustani, which was probably same thing.

Needless to say, the news was d cidedly anti-British, and they exhort all their Indian listeners to break fr from their English masters and jo with their brothers in Burma, wh had revolted against British tyrann The amount of actual news was ve small, most of it being straight propa ganda, not to mention treason.

At 1.50 am, the news was given Hindustani or some similar tongue, an the station left the air five minute later again with announcement English. The speaker definitely sound ed like an Indian, so it is quite pos sible this is a rebel station operatin somewhere in that country, though, o course, there is also a possibility it just another cunning Japanese scheme

By last mail we received a car from Mr. Cushen in New Zealand, i which he mentioned an Indian Freedom Station, which he had been bearing on 9380kc. 31.9m. He interprete the Hindustani slogan as "This is Ada Zindabal," so more than likely this is the same station as we heard on 11,500kc. Mr. Cushen gave the operating times of the one he heard as 1 am till 1.30 am, news in English at 1.15 am.

Up till the time of writing we have not heard this Freedom station on 9380kc., so perhaps it has changed to 11,500kc.

READERS' REPORTS

THE following readers have sent in reports and interesting letters, for which we are very grateful:—Mr. J. Roberts, Rosebery, NSW; Mr. R. Hallett, Enfield, NSW; Mr. R. K. Clack, Beresfield, NSW; Mr. A. Cushen, Invercargill, NZ; Mr. H. Cox, Cobden, NZ; Dr. K. B. Gaden, Quilpie, Q.; Mr. E. Dobbs, Stanmore, NSW; Mr. E. C. Jamieson, Forreston, SA; Mr. J. Buckley, Goulburn, NSW; Mr. H. Perkins, Malanda, Q.; Mr. I. L. Hill, Nulkaba, NSW; Mr. M. Foster, Mount Vincent, NSW; Mr. Hanson, Merrylands, NSW.

VERSEAS S.W. STATIONS NOW AUDIBLE

The list of stations shown below comprises only those which have actually been heard in this country during the past few weeks, and does not include stations which are on the air but not heard as yet in this country. A large majority should be heard on any sensitive receiver, and when a station is reported for the first time, readers' names who report it are shown in brackets. At the end of each group is a list of our correspondents who have sent in reports on these stations.

TIMES ARE SHOWN AS EASTERN STANDRD TIME

ENGLAND

—6050kc, 49.59m, Daventry. European service. eard best at 6.9 am. Frequently marred by irling noise.

—9510kc, 31.55m. Pacific service. Opens now 4.10 pm. Also heard from 1 am to 3 am, with ews at 2 am.

C—9580kc, 31.32m. North American service. This one of the station which will be heard at greater rength in the coming weeks.

D—11,750kc, 25.53m. Used in the African and acific services. Fine signal at 5.45 am and at 10 pm.

E—11,860kc, 25.29m. Usually a poor signal but an be heard at 5 pm.

F—15,149kc, 19.82m. Pacific and Eastern services. his is invariably a reliable transmission. Listen or News at 9 pm.

G—17,790kc, 16.86m. Always a strong station in rench transmission at 9 pm. Also joins Pacific ervice at 6 pm.

I—15,260kc, 19.66m. Fair signal at 6 pm.

L—6110kc, 49.10m. Home service. This can be eard in early morning and at 4.30 pm.

N—11,820kc, 25.38m. Heard strong at 6.30 am and at 9 pm in European service. Also used in oreign programmes in forenoons.

H—21,470kc, 13.97m. Although 13m stations have been poor this year, this one is heard at 9.15 pm on opening. French B'cast in progress independent of GSG. European service.

SO—15,180kc, 19.76m. Used in foreign language service, opening at 10.15 pm.

SP—15,310kc, 19.60m. Pacific service. Heard at 6.30 pm and at 8.30 pm.

SV—17,810kc, 16.84m. Eastern service. This station is heard at good strength on opening at 9.0 pm. Also heard at 2.0 am.

SW—7230kc, 41.49m. European service. At 5.0 pm, this is a fairly good signal. The news bulletins on this service are usually interesting

RD—15.450kc, 19.42m. One of the recent additions to the BBC Short-wave Services. Is heard at 7.30 pm and also at 2 am.

RE—15,375kc, 19.51m. Another recent addition. Can be heard at fair strength at 8.45 pm.

RG—11,680kc, 25.68m. African service. Never a strong signal, but can nevertheless be heard at 5.30 am.

RH—9825kc, 30.53m. A good station in the morning at 7.15 on opening. Will shortly be heard throughout the forenoons.

GRI—9515kc, 31.86m. Heard irregularly at nights at 9.30 pm.

GRJ—7320kc, 40.98m. European service. Regular transmissions at 6.0 am and 6.0 pm.

GRK—7185kc, 41.75m. This one is used in the Home service and can be followed at 6.0 pm and 3.0 am.

GRM—7250kc, 41.38m. Also used in the foreign service. Another one for the night-owl, heard at 2.0 am.

GRN—6195kc, 48.43m. Good station at 6.15 am and at times can be followed much earlier.

GRO—6180kc, 48.54m. African service. Heard only in early morning.

GRP—17,890kc, 16.77m. Much weaker than GSV, but can be heard from 9.0 in Eastern service.

GRQ—18,030kc, 16.64m. Is used in Eastern service, also with GSV and GRP, but is very weak. The beam in this case is directed to the West Indies.

GRR—6075kc, 49.38m. Gives News at 5.0 am. Have also heard this one in News at 4.0 pm.

GRS—7065kc, 42.49m. Pacific service. This one is great favorite of ours, being heard often when conditions are not so good on other bands.

GRU—9450kc, 31.75m. A very strong signal on opening at 11.30 pm and maintains its strength until closing at 1.15 am.

GRV—12,040kc, 24.92m. European service. Opens at 3.0 am at fair stregnth, giving News at 4.0 am. Also noticed at 6.30 am.

GRW—6145kc, 48.82m. Home service. Often heard at 5.0 pm and at 2.0 am, when it remains on the air until 8.0 am. Has been fading out by about 7.0 am.

GRX—9690kc, 30.96m. European service. With care can be logged at 6.0 am with News in English.

GRY—9600kc, 31.25m. Pacific service on opening at 4.10 pm, and has been reported as being heard weakly at 9.0 pm.

The following readers reported stations in the above group: Cox, Hallett, Roberts, Clack, Jamieson, Gaden, Perkins.

INDIA AND ASIA

All stations under Japanese control are listed under old call letters where new call letters are unknown. The absence of the Batavian stations is particularly noticeable, and we are keeping a close watch on these frequencies in the event of their being used by the Japanese during their sojourn in the country.

VUD2—6130kc, 48.94m, Delhi, India. Very fine signal from this one at 11 pm nightly.

VUD3—15,290kc, 19.62m, same location. Has been reported as audible weakly at 12.30 pm in News in English. Never heard at this location at this time.

VUD4—9590kc, 31.28m, same location. There should be some very interesting broadcasts made from this fine station in the near future. They can be heard on opening at 9.0 pm in an English transmission. Hindustani is also used.

XGOY—11,925kc, 25.14m, Chungking, China. Heard from 6.30 pm, reaches very good strength later in the evening.

XGOY—5950kc, 50.42m, same location. Heard at 6.0 am and at 10.30 pm.

XGOY—9625kc, 31.17m, same location. Has been reported as giving News at midnight. Must look this one out.

XGOY—9635kc, 31.13m, same location. Heard by Mr. Hanson in special transmission to USA. This between 1 am and 1.30 am.

XGOX—15,200kc, 19.74m, same location. News in English at 7.30 pm every night. Also heard by Dr. Gaden at 9 am, calling KRCA.

XGOA—9820kc, 30.86m, same location. Heard frequently at 9.30 pm. Heard once at terrific strength at 1.35 am.

XPSA—8465kc, 35.44m, Kweiyang. Heard in native programme every night.

XGOI—9665kc, 31.04m, Shanghai. Opens at 10 pm with announcements and follows with News in English at 10.15 pm.

XGRS—11,640kc, 25.77m, same location. German-owned station. Can be heard any night; easily identified as much English is used.

XMHA—11,855kc, 25.30m, same location. Very hard to hear when DJP is operating, but has good signal.

XIRS—11,980kc, 25.04m. This Italian-owned station is neither as powerful or as interesting at XGRS.

XGAP—6100kc, 49.18m, Pekin. English programme, opening at 11 pm and continuing until midnight. Fairly strong these last few nights.

XLMA—9350kc, 32.09m, China. Poor transmission; can be easily identified by rough signal.

XGOK—11,650kc, 25.75m, Canton. Heard well at 10 pm. Irregular.

FFZ—12,060kc, 24.88m, Shanghai. This station has been a regular night station for over two years. It is often spoilt by Morse, but when it does get through, it is a fine signal. They use a special system of modulation.

MTCY—11,775kc, 25.48m, Hsinking, Manchukuo. Reported as heard at 4.30 pm, with English announcements. Not heard at this location.

WHO'S WHO IN SHORT-WAVE BROADCASTING

CB1174 SANTIAGO, CHILE.

Frequency. 11,740kc, 25.55m. Power 4kw.
Operating schedule. Midnight till 2.30 pm. Sometimes opens 10 pm.
Standard time. 15 hours behind E.A.S.T.
Distance from Sydney. Approximately 8000 miles.
Postal address. Orlandini & Raggio Ltd., Casilla 6009, Santiago, Chile.
Identification. Announces as "Radio Hucke" and relays CB93. Occasionally announces in English.
Verification details. This station sends a very nice letter in English verifying reports on their station.

TPZ ALGIERS, ALGERIA.

Frequency. 12,120kc, 24.75m; also TPZ2, 8960kc, 33.48m. Power 10kw.
Operating schedule. 10 pm till midnight, 4.30 am till 6.15 am and 7 till 9 am. TPZ2 also 5 pm till 6 pm.
Standard time. 10 hours behind E.A.S.T.
Distance from Sydney. Approximately 8800 miles.
Postal address. Radio Algiers, L'Enfenieur en Chef des P.T.T., 137. Rue de Constantine, Algiers, Algeria.
Identification. Announces in French as Radio Algiers, both male and female announcers.
Verification details. Verifies by letter in French.

XEFT VERACRUZ, MEXICO

Frequency. 9550kc, 31.4m. Power 100 watts.
Operating schedule. Midnight till 4.5 pm.
Standard time. 16 hours behind E.A.S.T.
Distance from Sydney. Approximately 8000 miles.
Postal address. Independencia 26. Veracruz, Mexico.
Identification. Closes with announcement in English and man singing song.
Verification details. A very elaborate card is sent which shows call letters about three inches long.

MTCY—9545kc, 31.43m, same location. Good signal at 7 am until closing at 8 am.

MTCY—6125kc, 48.98m, same location. All programmes in local dialect. These Manchukuo stations are often heard at unusual times in tests with Rome and Berlin.

Radio Saigon—11,780kc, 25.47m. This frequency is now being used again with good results. The News in English is read at 9.30 pm.

Radio Saigon—6188kc, 48.48m, same location. A very loud station, opening at 10 pm. Closes at 2 am. News at 10.15 pm and 1.45 am.

CR8AA—6250kc, 48.00m, Macao, Portuguese China. Heard nightly with quite good signal.

HSP5—11,715kc, 25.61m, Bangkok, Thailand. This station is not as good as in the past, but can be heard on most nights at 10 pm. Lady announcer.

Freedom Radio—9645kc, 31.10m, Philippine Islands. This station is on the air daily at 7.30 am and 8.30 pm. The night transmission is heard well but the morning session fades out shortly after opening.

KZRC—6105kc, 49.14m, Cebu, PI. Can be heard nightly in their usual programme. This station is not under Japanese control.

KZRF—6140kc, 48.86m, Manila, PI. Under Japanese control, still announces as "The Voice of the Philippines."

KZRH—9640kc, 31.12m, same location. Also a Japanese operated station. Heard nightly with fair signal.

KZRM—9570kc, 31.35m, same location. Yet another Axis station which is now heard. This is not heard at the strength to which we were accustomed.

EQB—6155kc, 47.74m. A good signal at 4.45 am in its English session.

VWY—9045kc, 33.17m, Kirkee, India. Programmes directed to Syria are radiated from this station at 3.30 am. Announces as "Radio Francais libre d'Orient."

XYZ—6007kc, 49.94m, Rangoon, Burma. This popular station is now on a restricted time-table, from 10 pm to 11 pm.

ZHP1—9705kc, 30.90m, Singapore, SS. The only frequency in use at present. Interesting news heard, read by English announcer.

ZHJ—6095kc, 49.21m, Penang, SS. Also controlled by the Japanese and heard here closing at 9.45 pm. Announcements are in English.

ZBW3—9525kc, 31.50m, Hongkong, China. Heard every night at 11 pm. Can anyone supply the new call?

JZJ—11,800kc, 25.42m, Tokio, Japan. Always a good signal on opening at 7 pm. Mr. Simpson remarks as regards the bombs still hold.

JVW—7257kc, 41.34m, same location. Audible at 6 am at good volume.

JIE2—9695kc, 30.95m, Taihoku, Taiwan. News bulletin is heard at 9.30 pm and also at 11.30 pm. This, of course, in English.

The following readers reported stations in the above group: Cushen, Cox, Roberts, Perkins, Hill, Gaden, Foster, Jamieson, Hanson, Dobbs.

NORTH AMERICA

WGEA—6190kc, 48.47m, Schnectady, NY. We cannot hear this one with any regularity. When on the air is on at 8.30 pm.

WGEA—9550kc, 31.41m, same location. This one is good signal at 7.30 am and at 2 pm onwards.

WGEA—15,330kc, 19.57m, same location. An outlet of the General Electric which is now heard until 9 am and will soon be heard until much later in the forenoon.

WGEO—9530kc, 31.48m, same location. This one is beamed the wrong way for us. How is it being received in New Zealand?

WNBI—11,890kc, 25.23m, New York. Morning transmission and afternoon transmission heard well at this location. 6 am and 3 pm are the times.

WRCA—9670kc, 31.02m, same location. Good entertainment at 4 pm until closing. Reported also as heard at 9.30 pm but we cannot claim hearing them at that time.

WCBX—15,270kc, 19.64m, same location. Heard recently at 4 am, but not at any great volume.

WCBX—11,830kc, 25.36m, same location. The national transmitter in WA—VLW3 is the fly in the ointment here.

WCRC—11,830kc, 25.36m, same location. Test transmissions are emanating from this station.

WLWO—15,250kc, 19.67m, Cincinnati, Ohio. Heard at 5.30 am at good volume, but cannot be heard in afternoon.

WLWO—11,710kc, 25.62m, same location. This one is good until closing at 9 am.

WLWO—9590kc, 31.28m, same location. Today, the 29th, the carrier was just audible. This one should improve in the next few weeks as daylight reception improves.

WBOS—11,870kc, 25.27m, Boston, Mass. Some very fine talks have been heard from this city. They are easily picked up at 7 am.

WBOS—15,210kc, 19.72m, same location. Opens at 11 pm in parallel with WNBI, 16.87m.

WRUL—11,790kc, 25.45m, same location. News at 6.30 am. This one is heard now until 8.30 am.

WRUW—15.350kc, 19.54m, same location. Another outlet which is used in the same service as WRUL. It is always weaker than the latter.

KGEI—15,330kc, 19.57m, San Francisco, Cal. Heard weakly from 12.30 pm and increases in volume until at fair strength on closing at 2.0 pm.

KGEI—7250kc, 41.38m, same location. An outlet which has been heard at 5.0 pm. Some sound propaganda has been put out from the Fairmount Hotel studios. A good station at good volume.

KEL—6860kc, 43.73m; KEJ—9010kc; KEZ—10.400kc, 28.85m. These all radiate from Bolinas, Cal., carrying the same programme as KGEI. The most powerful is KEZ.

KKQ—7370kc, 40.71m, Kahuku, Hawaii. Not heard here but reported from Queensland as operating at 10 pm.

KJE8—9390kc, 31.95m, Los Angeles, Cal. This new station has been putting out test transmissions, and may be in service very soon.

KJE9—10,750kc, 27.91m, same location. Also testing.

CBFY—11,705kc, 25,63m, Montreal, Que., Canada. Can be read at 10.30 pm and increases in strength by 11.30 pm.

CFRX—6070kc, 49.42m, Toronto, Ont. Can be heard from 9.0 pm until 11 pm.

CJCX—6020kc, 49.83m, Sydney, NS. Audible at 10.35 pm at fair volume.

XEXA—6170kc, 48.62m, Mexico City, Mexico. A good night station, audible from midnight at good level.

XEWW—9503kc, 31.57m, same location. Always a reliable outlet for both late afternon and midnight sessions.

XEQQ—9680kc, 30.99m, same location. Also in use after midnight.

The following readers reported stations in the above group: Roberts, Cushen, Clack, Cox, Dobbs, Jamieson, Foster, Buckley, Gaden, Hill, Perkins.

CENTRAL AMERICA AND WEST INDIES

HP5A—11,700kc, 25.64m, Panama City, Panama. Easily heard at 8 am and at 11 pm.

HP5G—11,780kc, 25.47m, same location. Also heard at 11 pm, when opening. Easily identified (see April issue).

HP5J—9607kc, 31.23m, same location. This one is also well worth looking for at 10 pm.

HH3W—10,130kc, 29.62m, Port au Prince, Haiti. Heard well at 6 am.

HHBM—9660kc, 31.06m, same location. Listen for XGOI and tune a fraction lower in frequency.

TIEMC—11,900kc, 25.21m, San Jose, Costa Rica. Yet another one from this part of the world to be heard at 10 pm until midnight.

TIPG—9620kc, 31.19m, same location. Usually best of the Costa Rican stations. Also hear 10 pm.

TILS—6165kc, 48.66m, same location. Heard on day afternoons radiating until 3 pm. These tions are heard easily on Sunday owing to tended operating hours.

TGWA—9685kc, 30.98m, Guatemala City, Guatem Still heard only on Sunday afternoon till 4

TGWA—15,170kc, 19.78m, same location. Ano once-a-week station. This time on Monday m ing at 8 am.

YNRS—8585kc, 34.95m, Managua, Nicaragua. regular is fair from 10 pm.

COBC—9695kc, 30.94m, Havana, Cuba. Still be heard on their new frequency at fine volu This, of course, at 11 pm.

COCQ—8850kc, 33.90m, same location. A ver tile station which is now being heard here a am, 4 pm and 10 pm.

COCO—8700kc, 34.48m, same location. Uses E lish in sponsored programmes as from 10 pm.

COCX—9270kc, 32.36m, same location. 11 pm a 8 am are the times for this station. We fi this one is often marred by interference.

COCW—6330kc, 47.39m, same location. Rath weaker than the other Cubans but is quite rea able. Opens at 10 pm.

COCH—9435kc, 31.80m, same location. This is spo by morse, but at times is quite good.

COHI—6455kc, 46.48m, Santa Clara, Cuba. Lo for this one at 10 pm as at present it fad out after 11 pm.

The following readers reported stations in t above group: Gaden, Hanson, Perkins, Foste Jamieson, Cushen.

SOUTH AMERICA

HJCX—6018kc, 49.85m, Bogota, Colombia. Hav not heard this one myself, but has been reporte as opening at 10 pm.

HCQRX—5972kc, 50.23m, Quito, Ecuador. Also bee reported as audible on opening at 9.45 pm.

HCJB—12,460kc, 24.08m, same location. A furthe station that is heard at fair strength at 10 pr on opening.

CB960—9600kc, 31.25m, Santiago, Chile. Heard o Sundays at 3.15 pm.

CB970—9735kc, 30.82m, Valparaiso, Chile. This sta tion opens at 9.30 pm.

CB1180—11,975kc, 25.05m. A Chilean which can be heard any night at 9.30 pm.

OAX4J—9340kc, 32.12m, Lima, Peru. Can be heard every night at 11 pm. Also audible at 2 pm on Sundays.

OAX4G—6190kc, 48.47m, same location. This station is now improving and is good at 3.30 pm on Sundays.

CXA8—9640kc, 31.12m, Colonia, Uruguay. Should be audible at 4 pm, Sunday. Has been reported at 6 am.

PSH—10,220kc, 29.35m, Rio de Janeiro. This is a weak signal heard on Saturday at 9 am.

PRE9—6105kc, 49.14m, Fortaleza, Brazil. A fair signal opening at 7 am.

The following readers reported stations in the above group: Cox, Roberts, Jamieson, Hill, Gaden, Foster, Hanson.

AFRICA

ZOY—6002kc, 49.98m, Accra, Gold Coast. Just audible at 5 am. This is another which may improve very soon.

ZRH—6007kc, 49.95m, Johannesburg, South Africa. Add another country to your list by listening at 6 am for this one.

ZRK—6097kc, 49.20m, Capetown, South Africa. Reported as audible and relaying the BBC at 6.45 am.

ZNB—5900kc, 50.85m, Mafeking, British Bechuanaland. Also reported as relaying the BBC News at 6.45 am.

SUX—7865kc, 38.15m, Cairo, Egypt. An Arabic programme is heard in the morning until closing at 6 am.

SUP2—6320kc, 47.47m, same location. ESB station is coming in nicely as from 2.30 am until 3.0 am.

Radio Cairo—5980kc, 50.17m. Pleased to hear this one in the clear one morning. Fair strength at 6 am.

Radio Addis Ababa—9625kc, 31.17m, Addis Ababa, Ethiopia. A loud one in the early morning as it is audible at 1 am.

Radio Tananarive—6063kc, 49.48m, Tananarive, Madagascar. Used to be a strong station here about 12 months ago, but is now heard at fair volume from 1.30 am to 2.30 am.

CR6RA—9470kc, 31.68m, Luanda, Angola, Portuguese West Africa. Heard at opening at 5.30 am until it closes at 7 pm.

CR7AA—6035kc, 49.73m, Lourenco Marques, Mozambique. This has been heard at 6.30 am in parallel with CR7BE.

CR7BE—9840kc, 30.49m. Can be heard from 6 am, when News is read, until closing at 7.20 am.

NEW STATION LOGGINGS

THE following new stations have all been definitely heard and identified at our location since our last issue. Where call letters are not as yet known, station is listed under its location.

Kc.	Metres	Call	Location
5970	50.25	VONH	St. John's, Newfoundland.
6160	48.70	CBRX	Vancouver, BC, Canada
7220	41.55	VLQ4	Sydney, NSW.
11,500	26.09	"Voice of Free India"	India.
11,870	25.27	"Voz de Espagna de Santander"	Santander, Spain.

,970kc, 25.06m, Brazzaville, Free French a. We hear at fair strength at 4 pm in French News, and also at 5.45 am with News nglish.
10,140kc, 29.59m, Leopoldville, Belgian Congo. d station at 5 am. Closes at 5.30 a.m
—6060kc, 49.50m, Nairobi, Kenya Colony. ually losing strength but may be heard from am. Relays BBC News at 4 am.
2,120kc, 24.75m, Algiers, Algeria. Heard at strength at 7.5 am and 5.45 pm.
8960kc, 33.48m, same location. Heard at time as TPZ.
8035kc, 33.48m, Rabat, Morocco. Another ch-speaking station which can be copied at n.
9410kc, 31.88m, Dakar, Senegal. Again audible opening at 5.15 am. This one will increase olume during the next few weeks.
9755kc, 39.75m, Durban, South Africa. An- r elusive station which is heard when condi- s are good. The time is 1 am.
following readers reported stations in the group: Cushen, Foster, Jamieson, Hanson.

AUSTRALIA AND OCEANIA

9580kc, 31.32m, Lyndhurst. National pro- mme. 6.45 pm to 11.30 pm.
—11,880kc, 25.25m. National programme. Noon 6.15 pm.
—11,760kc, 25.51m. National programme. 6.30 to 10.15 am.
—9540kc, 31.45m. To N. America, 10.25 pm to 10 pm, and to SE Asia at 12.15 am to 2 am.
3—11,710kc, 25.62m. Heard at 3.55 pm to 4.40 n.
—11,880kc, 25.25m. National programme, 8.30 to 10 pm.
7—15,160kc, 19.79m. National programme, 6.30 to 8.10 am, noon to 3.40 pm. Also in service om 6.25 pm to 8.15 pm.
8—17,800kc, 16.85m. Can be heard from 5.55 until 6.15 pm. This is in the overseas service.
6—9580kc, 31.31m, Sydney. Another outlet ard by Mr. Hanson at 5 pm in an overseas ansmission.
9—7250kc, 41.38m, Sydney. A good transmission hich can be heard from 11.25 pm to 12.10 am.
—9615kc, 31.21m, same location. In service to ew Caledonia, 7.25 pm to 8.25 pm.
V2—9560kc, 31.38m, Perth, WA. National pro- ramme, 9 pm to 1 am.
V2—9650kc, 31.09m, same location. SE Asian rvice at 12.15 am until 2 am.
V3—11,830kc, 25.36m, same location. National rogramme. Starts radiating at 8.30 am.
AA—6130kc, 48.94m, Noumea, New Caledonia. eard on occasions at 5.30 pm in Free French rogramme.
he following readers reported stations in the ve group: Cox, Roberts, Hill, Jamieson, Gaden, kley, Clack, Dobbs, Perkins.

MISCELLANEOUS

XI—6120kc, 49.02m, Lahti, Finland. Heard at ood volume at 1 am.
X2—9500kc, 31.58m, same location. Can be heard ell from 5.30 am.
X3—11,870kc, 25.47m, same location. This Finn carries the same programme as OIX2.
ER3—6165kc, 48.66m, Schwarzenbourg, Switzerland. One of the best European stations at this time of the day. 6 am is the time.
ER5, 11,865kc, 25.28m, same location. Can be heard by dint of careful tuning at the time of 11 pm, Sunday.
VJ—6005kc, 49.96m, Vatican City. An irregular transmission, which may be heard at 5.15 am.
VJ—9660kc, 31.06m, same location. Another one for the very early listener. Is heard at 2 am.
VJ—11,740kc, 25.55m, same location. This station is heard in a very fine session at 5 pm. This is, of course, the POW service.
SW6—11,040kc, 27.17m, Lisbon, Portugal. One which has given us some very fine entertainment. Opening at 4 am and audible until 7.30 am.
missora Nacional—7305kc, 41.07m, Ponta Delgada, Azores. A catch worth listening for, as it is one of the most distant stations from Australia. Audible at 6 am until 7 am.
adio Mediterania—7035kc, 42.66m, Valencia, Spain. Opens with march at 6 am. Lady announcer.
AP—9465kc, 31.7m, Ankara, Turkey. Heard at fine volume at 5.15 am. English is spoken at this hour.
AQ—15,195kc, 19.74m, same location. A sister station at TAP, heard at 10.30 pm.
UB—6100kc, 49.18m, Belgrade, Yugoslavia. Good station at 5.30 am. Announcements are often in French.
BP—11,705kc, 25.63m, Motala, Sweden. This is an old regular, which is now found to be oper- ating at 9.45 pm on Sunday.
LKQ—11,735kc, 25.57m, Oslo, Norway. An Axis station heard irregularly from 3 pm.

PCJ—9590kc, 31.28m, Huizen, Holland. Nice to hear them again at 7.50 pm, when opening.
PCJ2—15,220kc, 19.71m, same location. Another outlet which is found at good volume, but is often spoilt by CW interference.
Paris—6200kc, 48.39m, Paris, France. A fairly new station, heard at 5.30 am when on the air.
Paris—9520kc, 31.50m, same location. Fine signal from this one at 5 pm.
Paris—11,880kc, 25.25m, same location. Another outlet easily heard at 5.45 am.
Paris—11,845kc, 25.53m, same location. A further evening transmission from this part of the world. Can be heard at 5.45 pm.
Paris—15,245kc, 19.69m, same location. Heard at fair strength at 5.30 pm.
Paris—17,850kc, 16.80m, same location. We find them regularly at 10 pm. Announcements in English are often heard from these stations.
Moscow—15,230kc, 19.70m. Transmission in English at 9.10 am.
Moscow—12,060kc, 24.88m. Transmission in English at 10.45 pm.
Moscow—10.040kc, 29.88m. Transmission in English at 11.30 pm.
2RO3—9630kc, 31.15m, Rome, Italy. These stations have been noticed using the old interval signal. The recordings of Canaries. A good signal at 3 pm and also at 7 am.
2RO4—11,810kc, 25.40m. Heard well until 5 pm. Not quite as loud as 2RO3.
2RO6—15,300kc, 19.61m. Also a good signal in the late afternoon.
2RO9—9670kc, 31.02m. Has been heard early in the afternoon, when it swamps WRCA.
2RO11—7220kc, 41.55m. Yet another one in the early morning sessions, at 6 am.
2RO15—11,760kc, 25.51m. An early morning station which has been reported as being heard at good strength.
2RO8—17,820kc, 16.84m. Heard frequently at 10 pm.
2RO20—17,780kc, 16.87m. Heard at the same time as 2RO8, when it carries the same programme.
DHE2A—6010kc, 49.92m, Prague, Bohemia. A good signal at 4.45 pm on closing.
DHE4A—11,840kc, 25.34m, same location. Heard well at 6.30 every morning.
DJC—6020kc, 49.83m, Berlin, Germany. Another morning station heard any morning at 6.0.
DXP—6030kc, 49.73m. Also on at 6 am.
DXX—6140kc, 48.86m. At 5.30 am they broadcast news in English.
DXJ—7240kc, 41.44m. One of the many Germans heard at 6 am.
DJW—9650kc, 31.09m. News in English is also heard from this one at 6 pm.
DZD—10,543kc, 28.45m. Heard in some locations quite well at 5.30 am.
DXR—11,760kc, 25.51m. A recent addition to the German service. Heard at both 6 am and 4 pm at good level.
DJL—15,110kc, 19.85m. News in English at 9.30 pm, and talks at 10.30 pm.
DJR—15,340kc, 19.56m. Opens at 3 pm and closes at 2 am. News at 5 pm.
DJH—17,845kc, 16.81m. Is heard at great volume at night, from 8 o'clock.
The following readers reported stations in the above group: Hallett, Gaden, Hanson, Cox, Dobbs, Hill, Jamieson, Roberts.

STOP PRESS

RETURN OF 13m. STATIONS

The 13m band having been so poor this summer, it is of no little interest when we do hear one. GSH, 13.97m, was heard at fair strength in a French broadcast opening at 9.15 pm. This transmission was a separate service to that over GSG. GSH has been used in the European service in the past, and it seems it is again being used in this service.

HOLLAND HEARD WELL AGAIN

It is very pleasing to notice that the blanket of horse has vanished from the frequency occupied by PCJ2. We hope that these conditions will prevail for some time to come.

HCJB HEARD IN MORNING

This station can now be heard at 8.15 am on Monday, on its usual frequency. Russian is spoken until 8.30 am in programme for the Argentine. From 8.30 am English is spoken until 9.15 am, when a relay of the news in English is taken from WBOS. We are indebted to Dr. Gaden for this information, and he adds that the strength is excellent.

NEW OUTLET FOR KRCA

A new outlet has been heard on 31.65m. The call is believed to be KEI. At 5 pm they are radiating in conjunction with KEL. The programmes originate in the Fairmount studios, as do all of the productions broadcast by this network. These stations are well worth watching, as new frequencies are continually being used in an endeavor to achieve some measure of world coverage.

ALL INDIA RADIO

WE are indebted to Mr. Clack for the following schedule:

DELHI

VUD2	7290kc.	12.30 — 2.00 pm	
		2.30 — 7.00 pm	
	4960kc.	9.00 — 11.45 pm	
	3495kc.	Midnight — 2.30 am	
VUD3	11,830kc.	Midday — 3.00 pm	
		9.00 — 11.45 pm	
	15,290kc.	4.30 — 6.55 pm	
	6085kc.	Midnight — 2.30 am	
VUD4	9590kc.	Noon — 3.00 pm	
		4.30 — 6.55 pm	
		9.00 — 3.35 am	

BOMBAY

VUB2	7240kc.	12.30 — 2.30 pm
		5.00 — 6.55 pm
	4880kc.	9.30 — 11.45 pm
	3365kc.	Midnight — 3.15 am

MADRAS

VUM2	7270kc.	Noon — 1.30 pm
		5.30 — 7.30 pm
		8.30 — 10.15 pm
	3435kc.	10.30 — 3.00 am

CALCUTTA

VUC2	7210kc.	Noon — 1.30 pm
		5.00 — 7.30 pm
		9.00 — 11.45 pm
		Midnight — 2.30 am

VERIFICATIONS

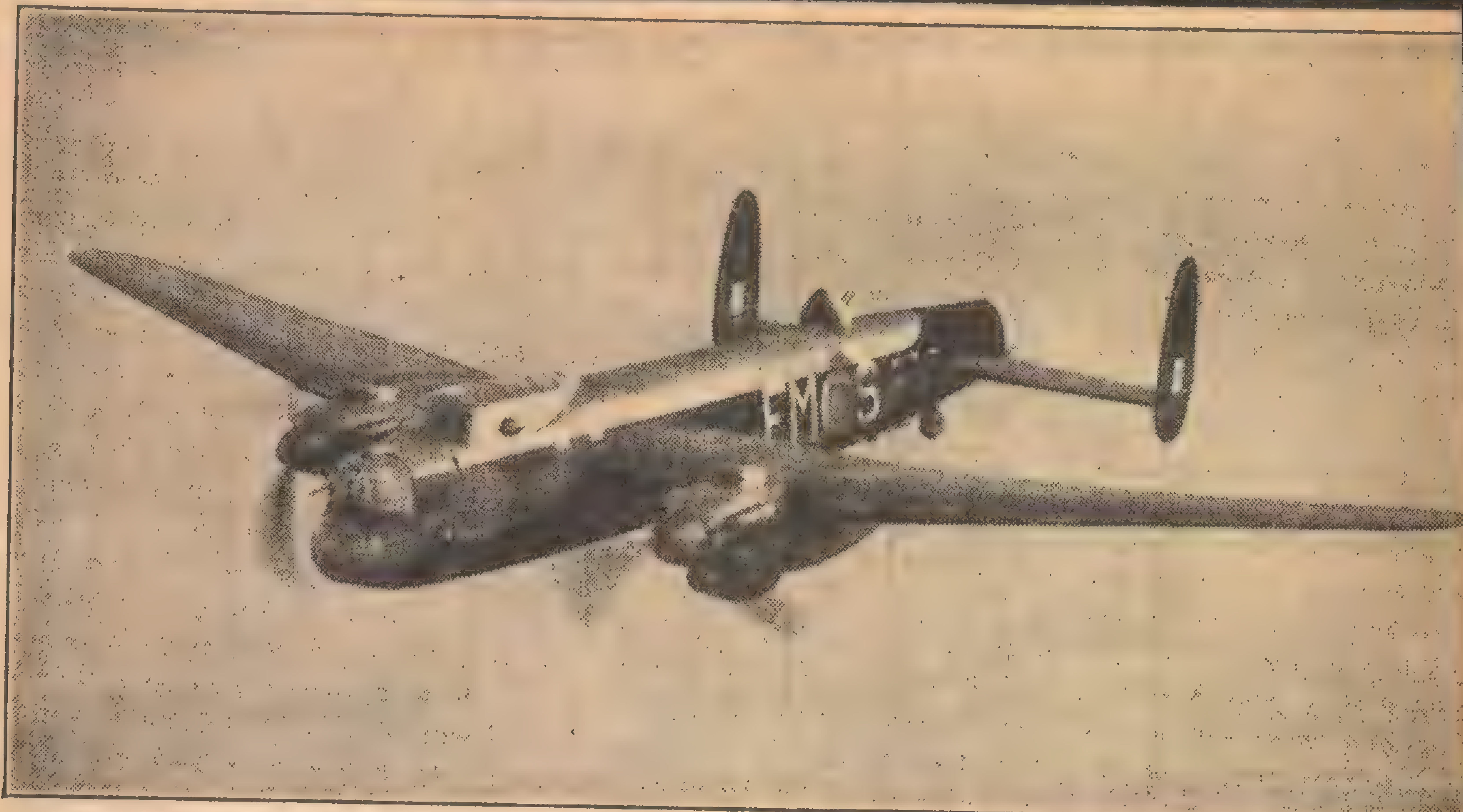
ALTHOUGH many ardent listeners are getting veri's through in fine style, there have been many inquiries as to whether this or that country is a suitable one for the purpose of sending reports, with the possibility of getting a card back. Some countries have always been slow in reply, while some seem disinterested and only rarely acknowledge a letter. At the present, in the absence of any official information from the postal authorities, it seems to us that verifications are possible from the Americas, Africa, China, Turkey, Portugal, and any part of the Empire. We will endeavor to obtain information as to which countries are at present reached by the postal service, and will try to get it in the next issue.

FREEDOM RADIO

IT is with regret that we read in the Press of the withdrawal to the island of Corregidor of the heroic defenders of the Philippines. We believe that the Freedom Radio station was located on the Bataan Peninsula, and so it follows that we have heard the last of them for the present. Having become accustomed to turning to them for the news, we now find that we must seek elsewhere. It so happens that at the present time there are plenty of stations broadcasting the news from the American angle, and so we will rely on these until we once again hear the call: "This is the Voice of Freedom."

THE surface area of the lungs has been estimated to be nearly two thousand square feet, that of the intestines fifty square feet, and the area of the red corpuscles of the blood to be nearly three-quarters of an acre.

THE TWIN-ENGINED AVRO MANCHESTER



A striking aerial picture of the Avro Manchester heavy bomber. Owing to the fact that the plane has only two motors, it does not appear as imposing as other large planes, such as the Halifax and the Stirling. However, the Manchester is only slightly smaller in its overall dimensions and carries practically the same bomb load. Speed is not stated but it probably is around the 300 mph mark.

Recently information has been released regarding three of Britain's new heavy bombers, namely, the Short Stirling, the Handley Page Halifax, described in last month's issue, and now the latest, the Avro Manchester. Frequently mentioned in recent months in official communiques, describing the activities of the Bomber Command, it has remained something of a mystery plane until just recently, when photographs and silhouettes were released.

IT was not a four-engined bomber as many had expected it to be, but a twin-engined bomber, which, although slightly smaller than the Stirling and Halifax, is nevertheless capable of carrying almost the same bomb load at a high speed.

It is, however, the largest twin-engined bomber in the world, and no doubt would have been of the four-engined class, had not the powerful new engines been available.

IT is manufactured by A. V. Roe and Co., Ltd., one of the oldest firms of aeroplane builders in existence, and, to give it its full title, it is the Avro 679, Manchester 1. It has appeared in service in two forms. One has the end plate fin and rudder, and also a central fin on the top of the fuselage.

The other, the later model of the two, has two larger fins and rudders at the extremities of the tailplane, the central fin being discarded.

Like all the latest bombers, the Manchester is heavily armed and armored. From photographs and information available, it would appear to have a four-gun rear turret, an "egg" shaped dorsal turret on the back, and a front turret, the latter turrets containing two guns each.

Whether or not, on even later versions a cannon turret has been installed, still remains a secret, but, as latest Halifax and Stirling bombers are being equipped with them, one may be fairly safe in assuming that the Manchester will also receive them.

by John French

The Manchester is a mid-wing monoplane of all metal stressed-skin construction, and follows the usual Avro standards of being fundamentally straightforward in its conception. Structure is simple and straightforward, thus making for easier mass production.

Another simplification as compared with other bombers of the large type is that all the bombs are carried in one large section of the fuselage, as near as possible to the centre of gravity, thus assisting the manoeuvreability of the plane.

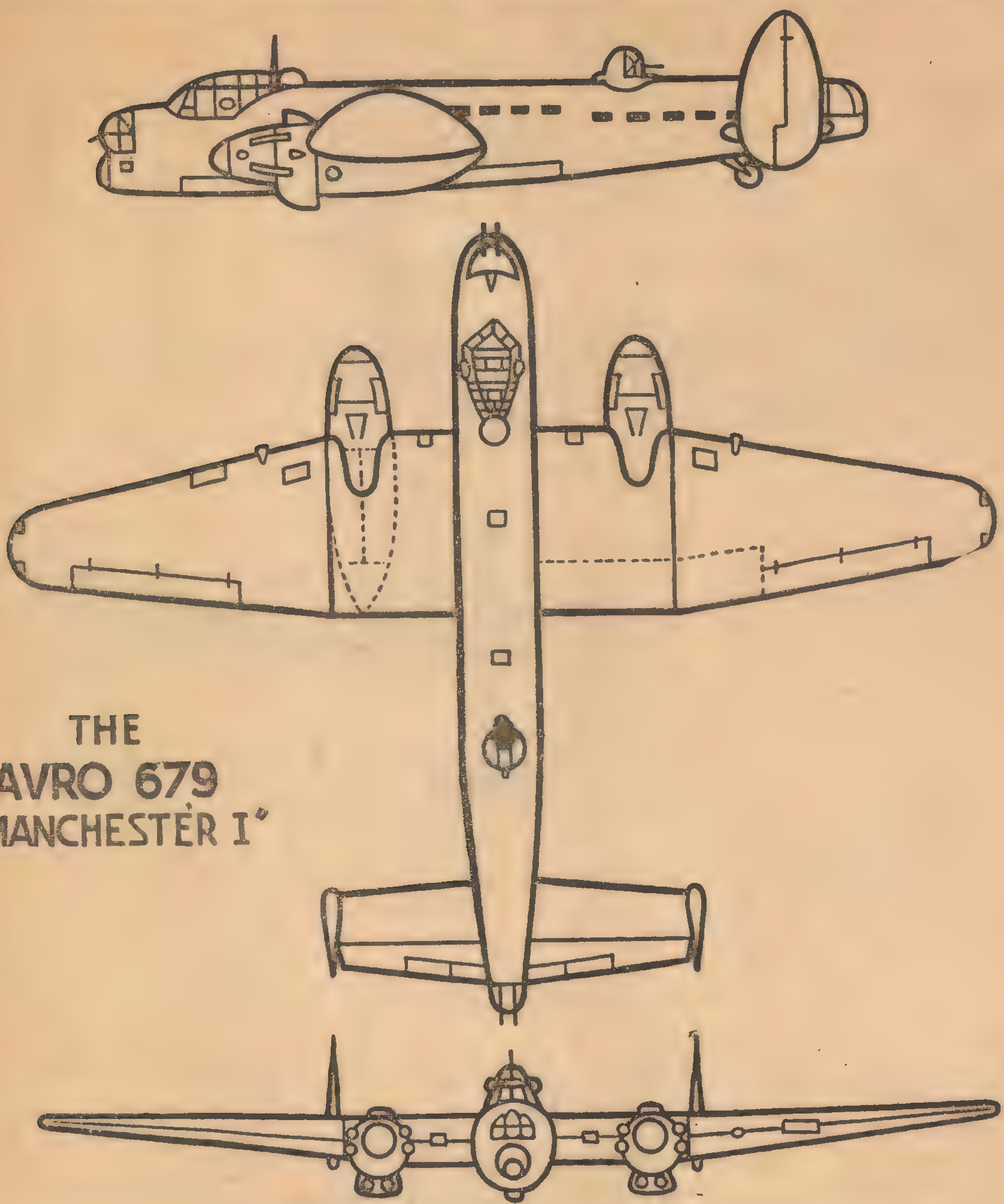
FUEL TANKS

The wing roots between the engines and fuselage house the fuel tanks. Fuel jettisoning gear is carried, and consists of a retractable flexible pipe, which, when lowered, hangs under the wing.

Another peculiar difference between it and other bombers is the fact that no de-icing equipment is carried in the wing, although it is carried on the tail unit. Splinter rings are fitted to the De Havilland Hydromatic full feathering screws. Balloon barrage cable cutters are installed on this bomber. Other large bombers are also being fitted with this device.

It would seem from these two facts

ANOTHER NEW BRITISH HEAVY BOMBER



THE
AVRO 679
"MANCHESTER I"

Here are the outline drawings for the Avro Manchester. Readers wishing to make a solid model of this plane should find no difficulty in doing so. Specific instructions are not given in the article but the same procedure can be followed as for the Handley Page Halifax, described last month. For details of the under carriage, have a look at the picture of the plane on the next page.

hat this bomber is to be used more or low level attacks.

EXHAUST DE-ICING?

The exhaust from the engines flows out through a large rectangular hole in the upper wing surface of each wing, according to the information available. Otherwise, I would have been tempted to say that the method of de-icing, as used in the latest versions of German bombers, was being used.

In many new German bombers, the hot exhaust is conducted through tubes inside the leading edge of the wing, around the wing tips, and then out through a hole in the trailing edge. The tailwheel is fitted, but the main undercarriage is fully retractable, when up, being neatly cowled into the motor nacelles. The crew carried can number either six or seven, comprising two pilots, navigator, wireless operator, and two gunners.

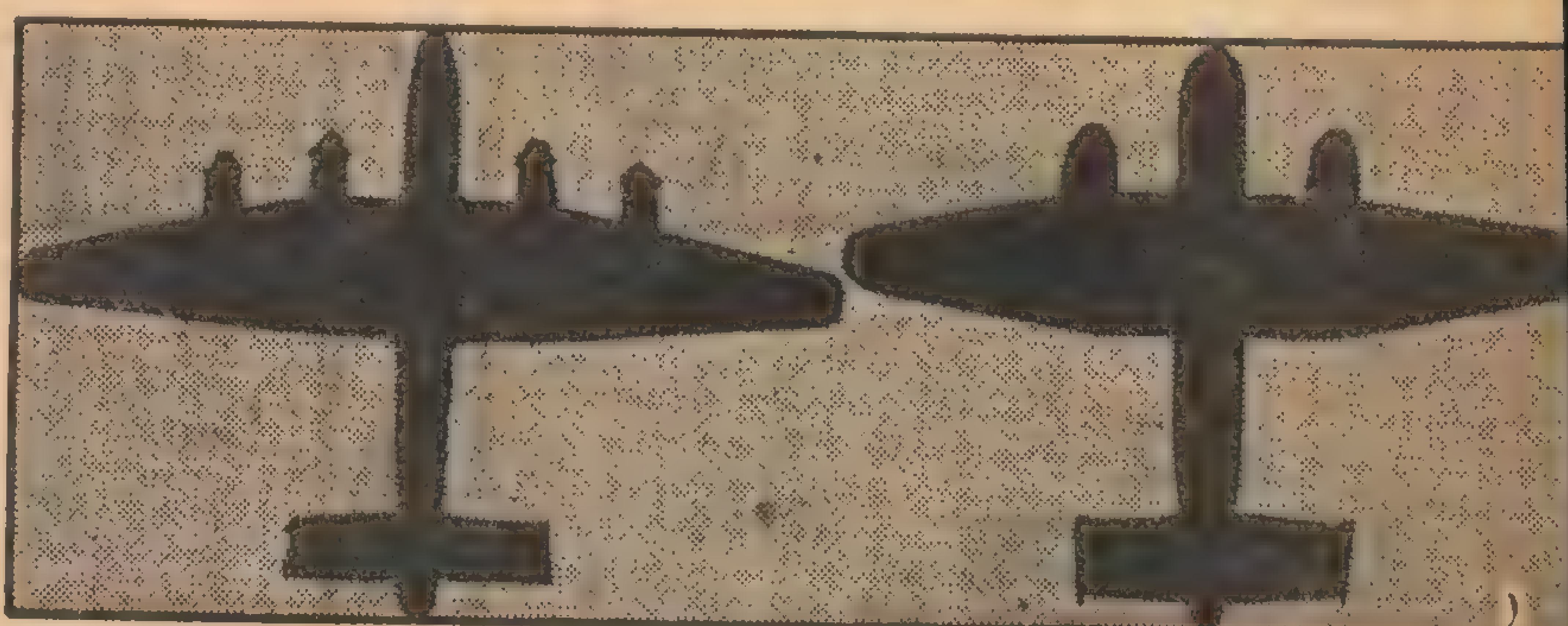
The seventh, when carried, is usually a new man "learning the ropes." The wireless operator is also the front gun-

(Continued on Next Page)

Getting ready for a flight over enemy territory. Some of the crew stand be as the bombs are wheeled under the plane. The bombs are stowed within the lower portion of the fuselage. Note how the open doors of the bomb bay extend from just near the nose to well back along the fuselage.

ner, while the navigator or second pilot is capable of handling the bomb sights.

The Manchester is quite capable of maintaining height and fair headway on one engine. In fact, some have flown home from enemy territory on one engine. Incidentally, the engines are



Although some of the minor details are not exactly to scale, these two silhouettes convey a good idea of the comparative size of the Handley Page Halifax on the left and of the Avro Manchester on the right. The wingspans are respectively 99 feet and 90ft. 1in. The length in each case is 70 feet.

the new Rolls Royce "Vulture," which is superseding the old Merlin in many planes; rated horsepower is 1760, although the actual figure is probably closer 2000. The motor is a 24 cylinder type.

The machine has, as yet, not been used on daylight raids, although if large day bombing of Germany recommences shortly, this machine will probably be used in preference to other heavier bombers.

Few details of performance been released, but the dimension available. The wing span is 90ft Length, 70ft. Height, 19ft. 6in. pare this with the Halifax, of spar 4in., length 70ft. 9in., height 22ft. and you can see that there is little difference. Top speed of the fax is approximately 310 mph, and though there is a total difference horsepower of approximately 1200, speeds ought to be nearly the as the drag on the Manchester been lessened, due to the cutting-o two engines.

Range is as yet unknown, alth it is probably between 3600 and miles, if the plane has to conform Air Ministry standards, which it do

Since the Manchesters have thus been used mainly in night raids, reasonable to assume that, at least majority of them, are colored as sh in the two photographs.

It will be seen that the upper face of the fuselage is painted i very light shade, possibly a silver color. The remainder of the plane finished in a dull black or a very d blue.

There are color markings on wings, and on the inside and outsi of the vertical fins. Color circles a squadron markings appear on eith side of the fuselage.

Modellers should not find it difficu to make a solid model of the Manches ter. The procedure would be along t same lines as for the Handley Pag Halifax, as described in last month issue.

THE PNEUMATIC HAMMER

(Continued from Page 11)

shows the bar depressed and the machine in use.

The upward movement of the pump piston forces compressed air to the top of the hammer cylinder, driving down the piston in the cylinder with great speed. This, of course, takes the hammer down with it, and a blow is struck by the hammer-head on the piece of metal lying on the anvil.

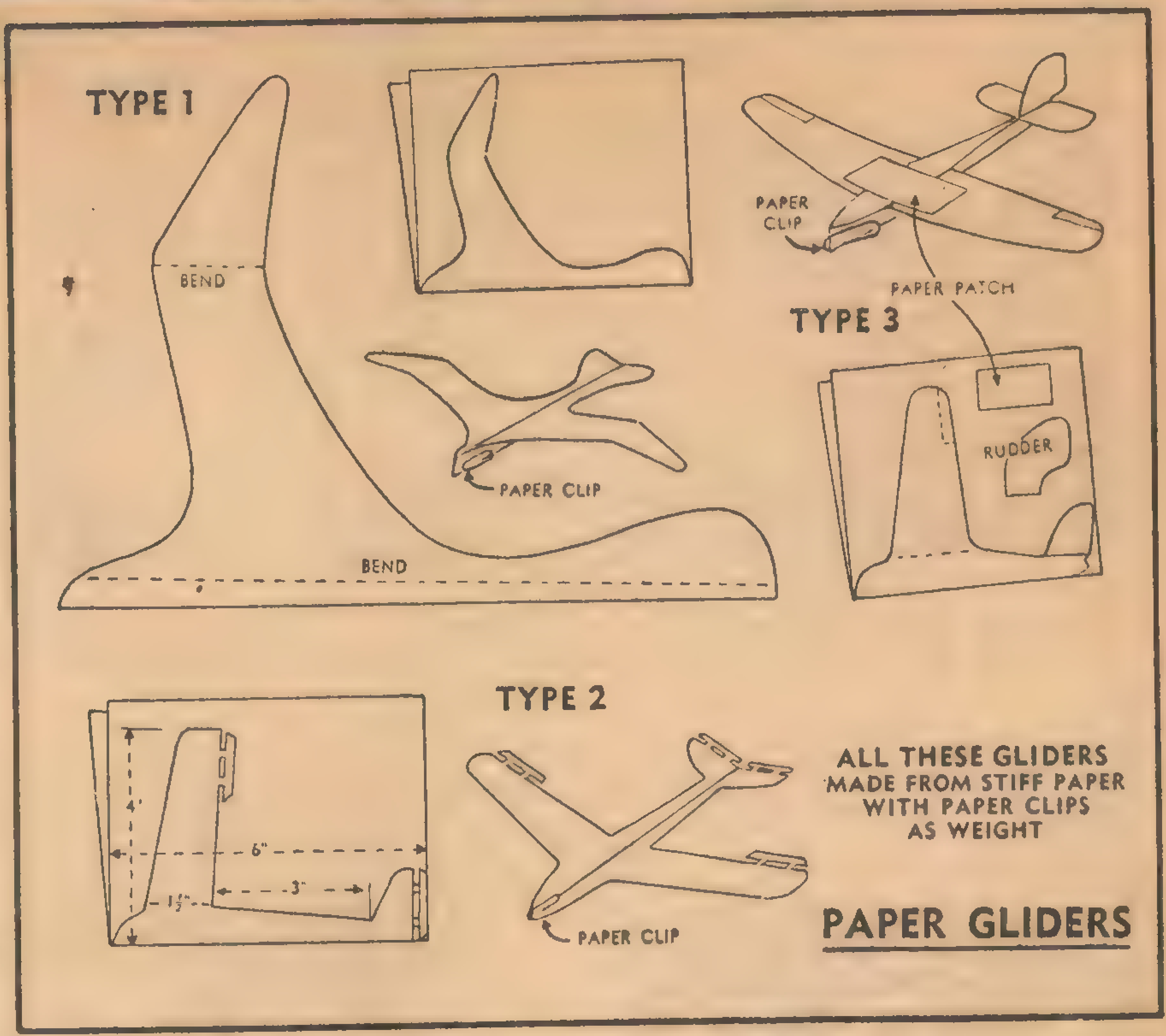
When the pump piston returns, it forces air under pressure through the lower passages, and so causes the hammer piston to move upward, ready fo the next stroke; and so the proces goes on, making it possible for the ma to hold and mould the red-hot meta

When the operator does not wis to have the "hammer" in operation h takes his foot off the bar, and this i turn moves the control valve, which i then in the position indicated by dotte lines.

The air can circulate freely in the passage from the top to the base of the pump cylinder only, without affecting the hammer in any way.

FUN INDOORS WITH PAPER GLIDERS

How many of us have not often paused to watch young schoolboys making and flying paper gliders? Their folded slips of paper are a far cry from the gliders and model planes usually flown by older enthusiasts.



HOWEVER, there is quite a lot of fun to be had indoors from flying small paper gliders. Here are three models capable of making some excellent flights.

The essential details are shown in the sketch. Precise measurements are scarcely necessary, since it is a simple matter to sketch the model to the general outlines and to the proportions shown.

The main point to watch is in regard to the thickness of the paper. If you are making a small model, ordinary stout notepaper will be quite sufficient. For larger models you will find it necessary to use very heavy paper or even light card.

If the paper is too heavy, the model will not glide gracefully and will lose height rapidly owing to excessive weight. If the paper is too light, on the other hand, the wings will naturally tend to buckle.

MAKING TYPE ONE

Type 1 is perhaps the easiest of the three to make, but needs to be carefully adjusted and launched if it is to fly properly. The wingspan of the original was approximately ten inches. However, with ordinary heavy notepaper you will probably find that the limit is about seven inches.

First obtain a suitable sheet of notepaper and bend it in the centre. Draw the design in pencil on one side only, and then cut the plane out with the sheet still folded.

This method ensures that the plane will be symmetrical and is more satisfactory than trying to cut out the two sides separately. Crease the paper along the lines indicated in the sketch, and bend them to the desired angle.

WEIGHTING THE NOSE

The nose will need to be weighted by a small paper clip, by a piece of chewing gum, or by a small piece of sealing wax. The weight has to be adjusted so that the glider will glide fairly smoothly with just the slightest tendency to stall.

If desired, the tendency to stall can be eliminated by curling the extreme tips of the wings slightly upward.

In flight, the glider reminds one of a seagull because of its shape and because it glides with a slight dipping motion. At the same time, there is a tendency for the wings to flap a little. If you are artistic, a little touching up here and there will increase the illusion.

Be careful not to launch the model too vigorously, or it will fold up under the strain.

TYPE TWO

Type 2 is made in much the same way as type 1. However, the outlines are rather more conventional and, in

by
John French

addition, moveable tabs are attached to the wing tip trailing edge and to the trailing edge of the stabiliser. These can be used to govern the flight of the glider.

Note that the paper is not creased to form a fuselage. There is only a single crease along the length of the model, and the front view is simply a very shallow V.

A large version can be made up from stiff cartridge paper or light card, and plasticine can be used as a weight.

Type 3 is an extremely lively glider. The original had a body about 5in. long, a wingspan of about 8in., and a tail 3in. wide. However, the dimensions are not at all critical, and can be varied to suit your fancy and the stiffness of the paper available.

MAKING TYPE THREE

As with type 1, fold the paper in half and sketch the outlines of the model on one side. Next cut the model out and bend, as shown, to form the wing and tail.

The rudder is next cut out and glued in place between the two sides of the fuselage. The centre of the fuselage is kept apart by a paper patch, glued across the upper surfaces of the wing.

This patch should not be creased beforehand, as it will then tend to buckle, and will not strengthen the wings as effectively as it would without the crease.

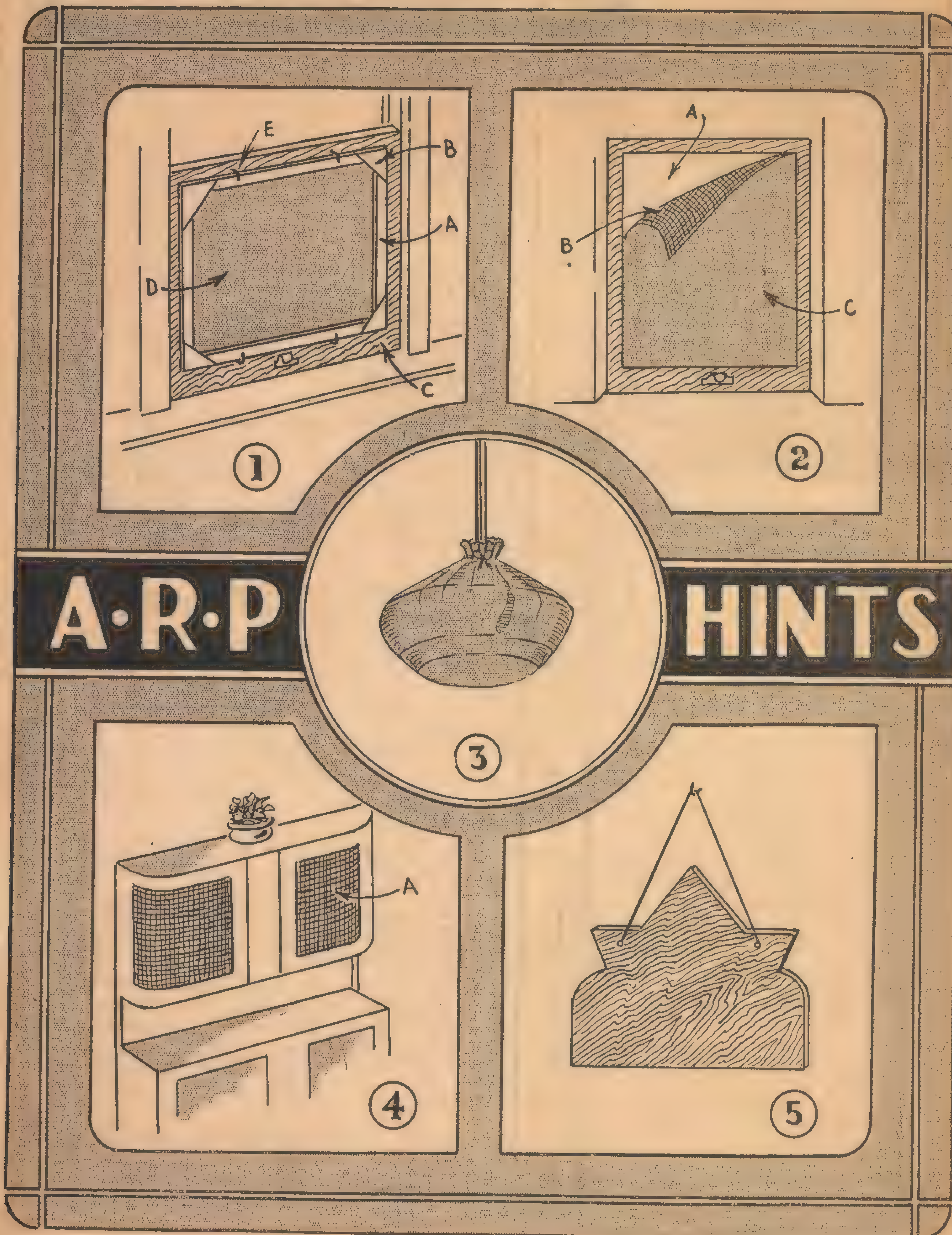
A paper clip in the position shown holds the nose together and also acts as a weight. This particular model looks very effective in flight, and can be made even more so by the addition of a red, white, and blue cockade and tail markings.

MOVABLE AILERON

However, it is well to do this while the model is still flat and before the patch is glued into place. The outer trailing edge of each wing can be snipped to form a moveable aileron.

Try these little jobs and see if you cannot better the flights of the usual type of paper glider.

PLANS FOR THE BLACKOUT SCREENS



PROTECT YOUR FAMILIES — A.R.P. HINTS

The importance attached by the authorities to the elimination of flying glass during air raids is evident in the regulations compelling stores to board up their plateglass windows. The average householder can scarcely be expected to take such elaborate measures but there are other relatively simple ways of protecting the occupants of an ordinary home from this same hazard.

The handyman cannot do much to prevent his home being damaged in the event of a bomb being dropped nearby. He can, however, take steps to minimise the chances of any of his family being injured by falling objects or flying glass. further, he can assist the authorities by blacking out the windows at night.

by *W. G. Nichols*

ALTHOUGH we have been asked for some time now to black-out our homes, it is surprising to note the number of people who have not yet attended to the matter. The permanent blacking out of windows by some suitable paint or by tacking plywood over them is very simple, but inconvenient during daylight.

The ideal system is a type of blackout screen which can be speedily removed and replaced at a moment's notice.

BLACKOUT SCREENS

A blackout screen that meets these requirements is shown in Fig. 1. First, make a rectangular frame from 1½in. laths, as used for making trellis work. The frame "A" in Fig. 1 should be larger than the window pane, but smaller than the window frame "C," as shown in sketch.

At each corner of the rectangular frame tack a triangular piece of plywood ("B") to strengthen the frame. On the reverse side of it, to which the triangular pieces have been secured, tack your blackout paper, folding the edges of the paper into two or three thicknesses so that the tacks will not pull through and so that it will form a cushion against the window frame to prevent light from escaping past the edge of the frame.

The method of keeping the frame in position is simple and effective. Four right-angled cup hooks ("E" in Fig. 1) are screwed into the window frame till they hold the screen securely. The two lower hooks are never moved, but the two top hooks are given a quarter turn to remove the screen when desired.

The screens may be kept out of sight but convenient to the windows. When the sirens blow, a four-pane window can be blacked out in less than forty seconds.

Shatterproofing is the term given to the precautions taken to prevent glass window panes, &c., from shattering and flying in all directions. Flying glass has caused much physical and material damage. A more accurate term would be "scatterproofing."

Many people are a little confused as to which is a reliable method of attacking the problem, but the method illustrated in Fig. 2 has come through actual tests with flying colors and can be definitely relied upon.

Cut a piece of mosquito net or similar material ("B" in Fig. 2) to such a size that it will cover the glass and about 1½in. of the window frame all around the four sides of the glass.

SHATTERPROOFING WINDOWS

First coat the window pane and adjacent edges of the window frames with a good reliable glue ("A"), press the mosquito net on to the window pane and frame, pressing firmly and smoothing out all wrinkles. Leave for about two

(Continued on Next Page)

AIRCRAFT ARE THE EYES OF THE ARMY

(Continued from Page 51)

The planes can be used in work that will release military planes for purely war purposes, instead of having hundreds of them spread over the nation to patrol areas that civilian-operated planes could patrol better, for the pilots would be flying mostly over their home territories, where they know local landmarks.

They could be used for highway traffic control, working with local police forces to direct traffic and thus minimise the congestion that would inevitably follow sudden evacuation. Belgium and France offered evidence of the extent of the disaster that could ensue from congested and blocked roads.

LANDING STRIPS

The construction should be considered of landing strips along main traffic arteries, so that all types of planes, military as well as civilian, would have more than one airport to land on. The light plane, however, can land almost anywhere, as they demonstrated to the Air Corps and the Army during the manoeuvres in Tennessee, when improvised fields and sometimes highways were used for landings and take-offs.

In that test, 102 separate pastures, roads and hayfields were used by Cub pilots during their missions. In their various tasks, they were more useful and more successful than Regular Air Corps observation planes, which had to be stationed at regular airports many miles from the scene of action.

The Cubs, however, could go right along with the "war." And often only a few feet above it.

WOODEN PLANES

And also, in view of the present shortage of metal, be it noted that light planes can substitute wood for metal in many parts. The great furniture-building industry of Australia no less than of the United States, could be put to work building wooden ribs and other wood parts for the light plane manufacturers.

Thus, instead of scuttling the light-plane manufacturer, as was the original American plan, and turning him into a parts producer, he would be set up as fairly big business himself, with thousands of wood-workers turning out parts for him.

That, by the way, is how the Germans built up many of the thousands of troop-carrying gliders which so recently intrigued the imagination of the US General Staff that it was induced to buy a "few" gliders.

Yes, let us learn from the Germans by all means. Learn from anyone, friend or enemy, with a good idea. But when you already have a better and more useful idea of your own, already built and working, why leave it idle?

The light plane exists in America in its thousands, the pilots in their thousands; and both with some vision and effort on the part of those in authority can be expanded rapidly into the tens of thousands. And the tens of thousands can be used.

National defence means largely air defence, in all its branches, civil and military.

JOE'S COLUMN

UNLESS you know the way to go about it, one of the most heart-breakin' jobs in a workshop is to try and drill a hole through glass. Even when you know how, it's still heart-breakin'.

The other day I came across a feller who had been about two hours tryin' to drill a quarter-inch hole in the bottom of a large bottle. He was usin' an ordinary metal drill and, after breakin' it twice, consumin' much energy and givin' vent to numerous cuss words, had managed to get down about a sixteenth of an inch. His workshop mates had lots of comments to make, but none were very helpful. One told him the correct way was to do it under water, but the feller drillin' was just about exasperated and he came back with "How long do you think I'd last under water?"

After another half hour's work he announced that he knew how to get a hole in the bottle for sure, but it would take about as long as he was takin' in tryin' to drill it. After a while we found that his idea was to stand it under a drippin' tap!

There are a few different ideas on how glass should be drilled, and I'll give you a couple here.

Grind a triangular file to a sharp point, keepin' the three edges sharp, and use this in an ordinary hand brace. If you have a drill press do the job at a low speed, and use turpentine freely as a lubricant. If you want to do the job faster, you can add silicon-carbide. As soon as the point breaks through drill from the other side—although that may be a little awkward if you're workin' on a bottle.

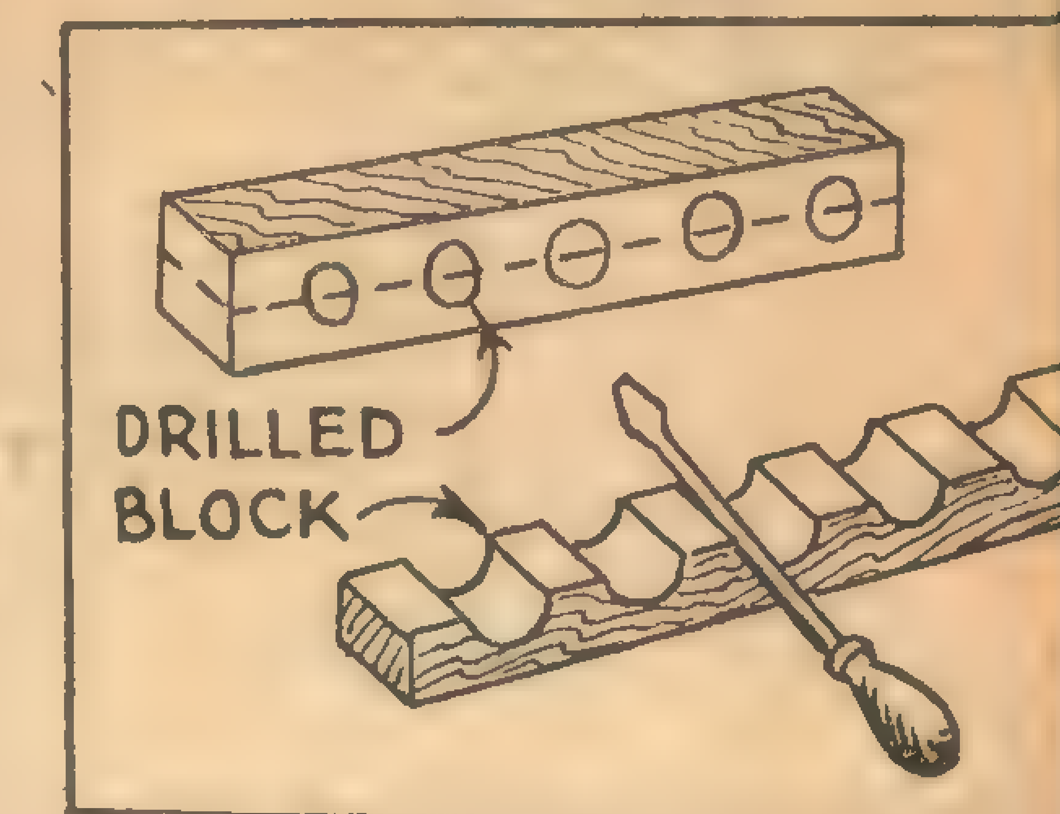
Another method is to use a piece of copper tubin' in a hand brace. Dip it in some glycerine and then into some carborundum powder. The powder will adhere to the copper and will grind the hole through. The advantage of usin' copper is that it is soft enough to allow the carborundum powder to become firmly attached to it and be carried round and so do the work. Also do this fairly slowly. If you turn to quickly it will have a tendency to throw the powder off before it really gets goin'.

Here's a brain teaser if you don't already know it. A man has a drawer in a room that has no light. In the drawer he has ten pairs of black socks and also ten pairs of grey socks, all mixed up together. He has to grope in the drawer in the dark and get himself a pair of socks suitable for wearin', either a grey pair or a black pair will do. The question is, how many socks must he pick out of the drawer before he is certain that he has a pair suitable for wear. I'll give you the answer next month.

THE EASY WA

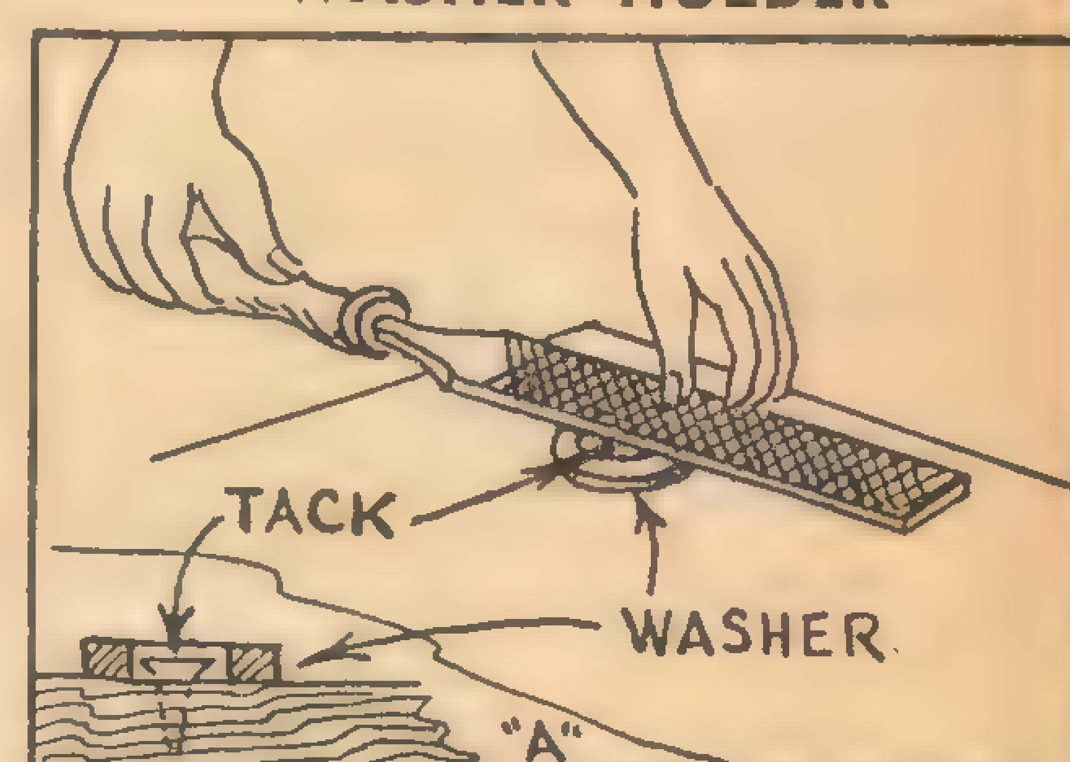
By WALTER G. NICHOLS

TOOL REST



A handy tool rest for the bench is easily ma by drilling a number of half-inch holes throu a length of one inch square timber, and th cutting the timber through the centre as sho by dotted line in sketch.

WASHER HOLDER



When filing a washer, slip it over a nail or tack making sure the head of the tack is below th level of the washer, as shown in sectional view "A" in accompanying sketch. You will find the washe is securely held.

A.R.P. HINTS

(Continued from Previous Page)

hours for the glue to dry, and then give the whole issue a coat of clear varnish ("C"), which completes the job.

We hear so much importance being attached to shatterproofing windows that we are apt to overlook other glassware around the home, which can also do much damage during an air raid.

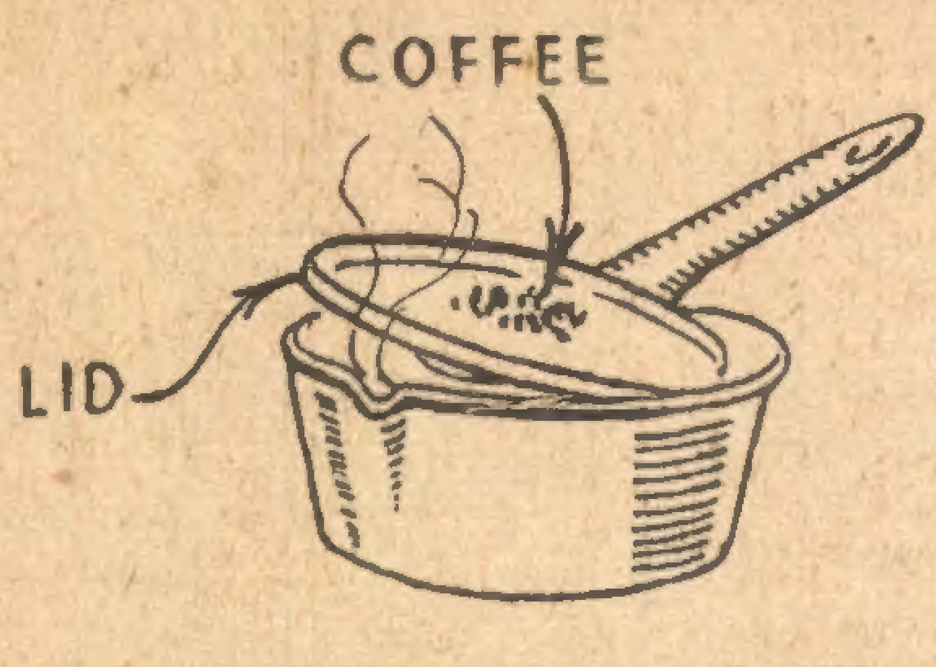
Glass electric light shades and globes are a potential source of danger, but if a bag of suitable size is made from mosquito netting and firmly secured around the light fixture by means of strong tape, as shown in Fig. 3, the glass will be prevented from flying indiscriminately around the room.

CABINET DOORS, ETC.

The matter of glass doors in kitchen cabinets, &c., can be attended to by tacking wire gauze such as is used for flyproof doors. The wire is tacked over the glass from the outside, as shown in Fig 4, "A." A thin wooden lath tacked over the wire gauze will prevent tacks from pulling through the gauze under the stress of shattering glass.

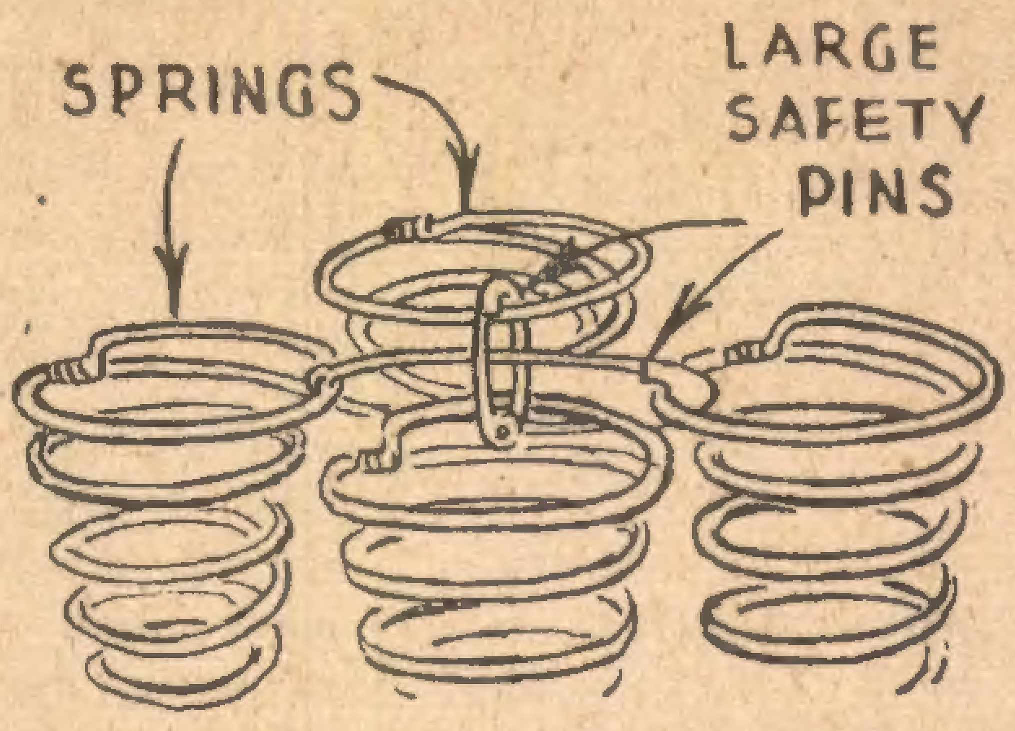
Decorative wall mirrors with heavy wooden backs should be turned mirror side to the wall, as shown in Fig. 5. In any room in which the family is sheltering during a raid, take the pictures off the wall, lay them face down on the floor and cover with a cushion or rug. Vases in use during a raid should be metal or wood. Remember, flying glass can do terrible damage. Act NOW.

USEFUL HINTS FOR THE HOME HANDYMAN



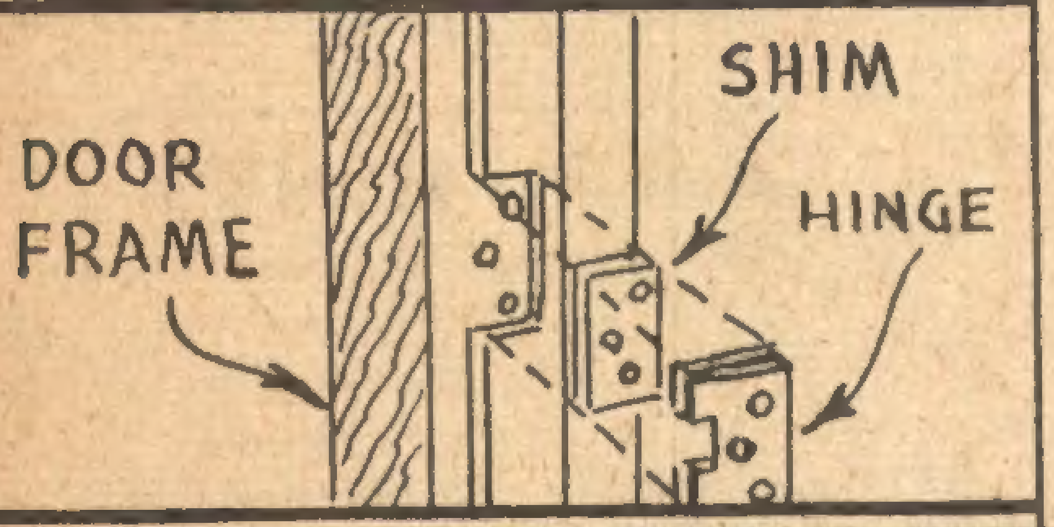
KITCHEN DEODORIZER

When boiling cabbage and other vegetables, turn the lid on the saucepan upside down or slightly to one side so that the steam curls over the lid. A little coffee placed in the lid will reduce odors to a minimum.



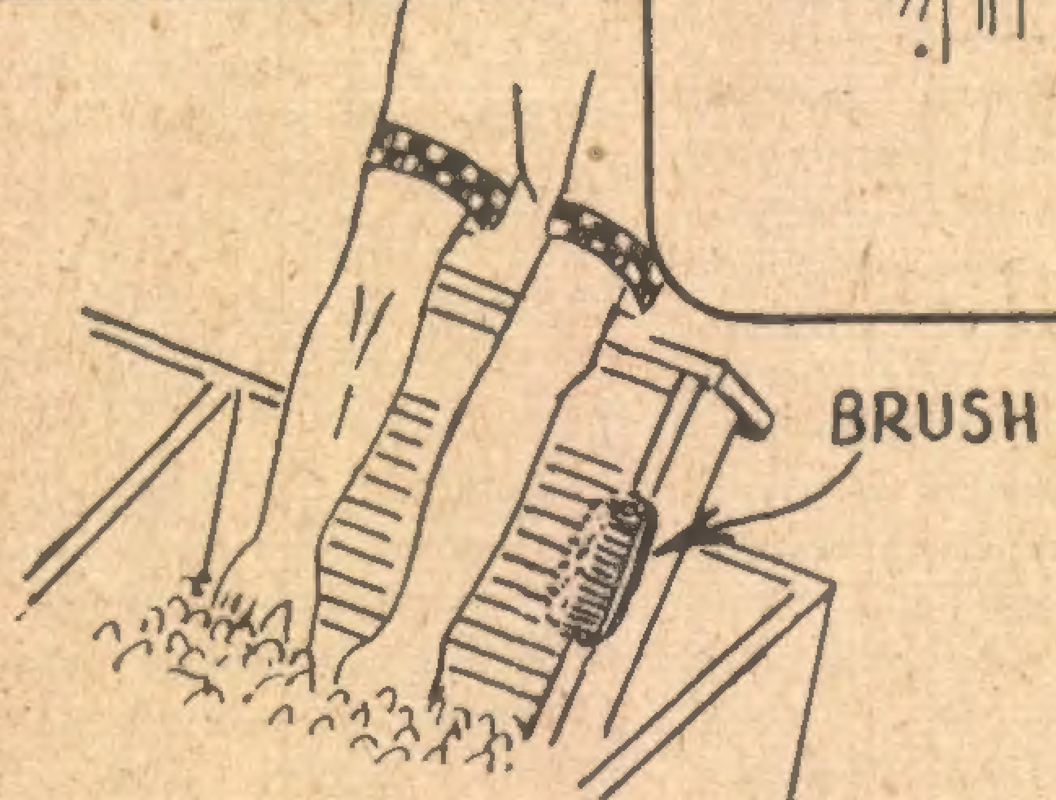
UPHOLSTERY HINT

When the springs in a seat or piece of upholstered furniture come adrift, they can be held together by means of long safety pins, as shown in the illustration.



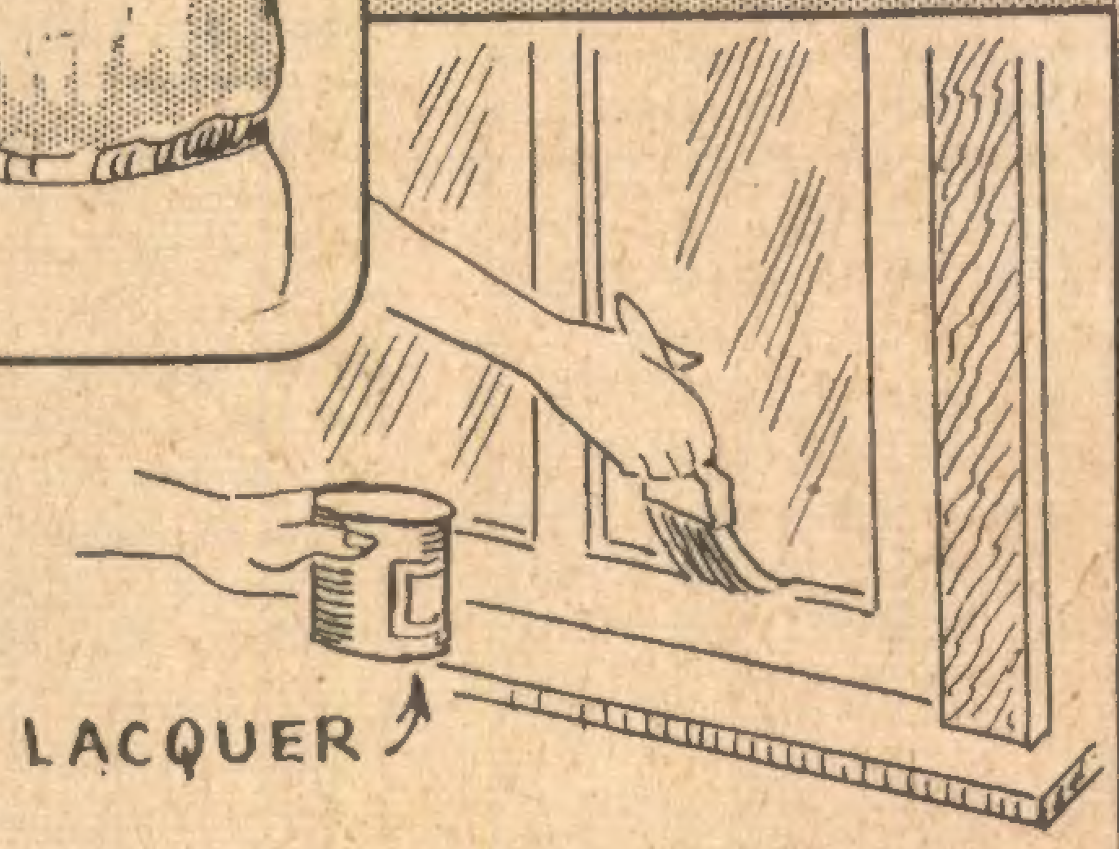
ADJUSTING SHRUNKEN DOORS

If one of the doors in your home has shrunk and the lock fails to engage the lock plate, remove the door and place pieces of shim metal between the hinge and door frame, as per sketch.



WASHING DAY SUGGESTION

A nail brush with strong bristles, firmly fastened to one side of your washing-board, will prove very useful for removing stubborn spots from clothes. Just apply a little soap and rub the cloth briskly on the brush.



FOR THE WINDOW REPAIRER

When repairing broken windows, you will find hardened putty much easier to remove if first given a coat of lacquer, which softens the putty in a short while.

BROADCAST BAND DX

by Roy Hallett

With the approach of winter, we usually say goodbye till next season to the North American stations heard around midnight, and the Europeans heard just before sunrise. At the same time, we look forward to improving signals late at night, and early morning, from the Asiatic stations, and perhaps to some North American and Pacific Island stations just after sunset during the winter months.

FROM now on, till the beginning of next summer, we should have good reception from New Zealand in the morning, from 4.0 am till they fade out, about 5.30 am and, of course, the splendid signals from some of them at night, which many of you enjoy.

MEXICO HEARD

Mr. George Rhodes, of Canberra, is the first reader to send along a report to these pages. He reports reception of a station announcing as located in Dalas, Texas, USA, which he heard between 7 and 9 pm, just off the end of the broadcast band.

I believe this station to be a Mexican, XEAW, whose transmitter is located at Reynosa, Mexico. This station broadcasts programmes in English for listeners in the United States, and has its offices, and possibly studios, at Dalas, Texas. Readers should try for this station, operating on 1570kc.

The normal broadcast band runs from 550 to 1500 kc, but many receivers are able to hear signals a little higher than 1500kc. Thanks for your interesting letter, Mr. Rhodes; do write again!

WATCH FOR PACIFIC ISLANDERS

A report from Mr. M. B. Schilling, of Wingham, NSW, tells us that KGMB, Honolulu, Hawaii, on 590kc, is heard quite clearly just after sunset, especially during the winter months. This station has also been heard by DX-ers in Victoria and by the writer. A typical American type programme is usually broadcast, so there should be little difficulty in identifying this station. Watch for it from now on around 6 pm. The signal last season was quite strong in many localities.

FJP, Noumea, New Caledonia, is another of the Pacific Islanders readers should watch for; this was first heard by the writer in July, 1941. It was then on approximately 558kc. but later changed to 560kc. Mr. Schilling has also reported hearing this station.

FJP broadcasts in the French language, as far as I know; no English is used. It was heard last season around 6 pm on 560kc, so watch for its appearance any time now. It relays the programme broadcast by the short-wave station, FK8AA, "Radio Noumea," on the 49-metre band.

ALL DX reports should be addressed to Mr. R. Hallett, 36 Baker St., Enfield, NSW. Reports for the June issue should be posted to reach Mr. Hallett not later than May 11.

Some North Americans may also be heard just after sunset during our winter months. XEAW, Reynosa, Mexico, 1570kc, and KFBK, Sacramento, USA, were two heard last year, the latter on 1530kc. It will be noticed that KFBK is another American heard just below our standard broadcast band frequencies.

Try for these latter two, and perhaps others between 1500 and 1570 kc around 6 pm. Other Americans may be heard on other channels at this hour, but they are usually jammed by Australian stations on the same channel.

MORSE CODE PRACTICE

Mr. George Cameron tells me that he is hearing Morse Code practice sessions from 2YC, Wellington, New Zealand, at 8.0 pm on 840kc. I am not sure what nights the service is on, but believe it to be all week-nights. Mr. Cameron says there is also a session at 4.30 pm which may be heard in Eastern Australia as winter approaches. The session is broadcast for signallers in the NZ fighting services.

1941-42 MIDNIGHT AMERICANS

Usually, each year, from about October to April, American stations are audible in Eastern Australia around midnight. The season now passing was quite a successful one, as quite a number of splendid signals were received. Mr. Gordon Obey has been hearing some of these at his location at Bronte, NSW. He mentions KNX, Los Angeles, 1070kc., and KSL, Salt Lake City, 1160 kc., as being strong stations. KNX, he says, has a good news service at 1.0 am.

He also mentions hearing KFPL, Dublin, Texas. He heard it on approximately 1310kc., but, according to station lists in the hands of the writer, KFPL is now on 1340kc. Mr. Obey did well to log this, as it is not a very high-powered station. He also mentions XGLO, San Domingo, on approximately 1290kc., which is a new one to the writer.

Actually, XG is the official prefix for China, and there is a Mexican, XELO, on 1190kc., located in Tijuana, so perhaps it is XELO our friend is hearing. But let's hope that he has logged a new station for us.

LISTEN FOR THESE

Here is our usual list of some stations which may be heard in Eastern Australia during the next month or s[o].

NEW ZEALAND

Try for these from the time the[y] open, 4.0 am, with BBC news, followe[d] at 4.15 by morning music, till they fad[e] a little after 5.0 am:—

2YA, Wellington, 570kc.
1YA, Auckland, 650 kc.
3YA, Christchurch, 720 kc.
4YA, Dunedin, 790kc.
1ZB, Auckland, 1070kc.
2ZB, Wellington, 1130kc.
4ZB, Dunedin, 1280kc.
2ZA, Palmerston North, 1400kc.
3ZB, Christchurch, 1430kc.
4YZ, Invercargill, 680kc. (Opens 5.0 am good signal.)
2YH, Napier, 750kc. (Opens 5.0 am with recording of BBC news.)

ASIA

These Asiatics may be heard from around 11.30 pm till around 2.0 am. All Indian stations relay news from Delhi, 1.50 am.

XGAP, Peking, China, 640kc.
Nanking, China, 660kc (not a very strong station). XGOC.
VUT, Trichinopoly, India, 758kc.
VUC, Calcutta, India, 810kc.
HS7PJ, Bangkok, Thailand, 825kc.
VUD, Delhi, India, 886kc. (on till about 3.30 am).
XOJB, Shanghai, China, 900kc. (usually closes 12.10 am).
VUW, Lucknow, India, 1022kc.
VUL, Lahore, India 1086kc.
VUY, Dacca, India, 1167kc (usually the best of the Indians).
XGOA, Chungking, China, 1200kc. (news midnight in English, not very strong).

NORTH AMERICA

Listen at midnight for the following:

WOAI, San Antonia, 1200kc (best around 10.30 pm).
KVOO, Tulsa, Okla., 1170kc.
KSL, Salt Lake City, Utah, 1160kc. (opens 11.0 pm usually).
KNX, Los Angeles, 1070kc.
KOMO, Seattle, Wash., 950kc.
KOA, Denver, Colo., 850kc.
KIRO, Seattle, Wash., 710kc.
KPO, San Francisco, 680kc.
KFI, Los Angeles, 640kc.

READERS' REPORTS

We are very grateful to the following readers, who have sent in interesting letters and reports on their station loggings:—Mr. George Rhodes, Canberra; Mr. M. B. Schilling, Wingham; Mr. George Cameron, Mosman; Mr. George Obey, Bronte; Mr. Ted Whiting, Five Dock.

ANSWERS TO CORRESPONDENTS

UNDER THE PERSONAL SUPERVISION OF THE TECHNICAL EDITOR

RADIO AND HOBBIES INFORMATION SERVICE

FOR the benefit of our many readers, we maintain two distinct information services. The first of these, conducted on these pages, is open to all and is quite free. If you have a problem which is bothering you, write in to us and we will do our best to give you the answer in the next issue.

However, remember that our issues are on sale at the beginning of each month and that they go to press in the middle of the preceding month. Therefore it is wise to get your queries in during the first two weeks of each month.

For those who cannot wait until the end of the month for the answer, there is the "Shilling Query Service." If you send in your query, accompanied by a postal note for one shilling, we will answer your query by letter as quickly as possible. You will understand that, with reduced staff, such letters have to be attended to when the opportunity occurs.

Make your letters brief and to the point. If you can number your questions, so much the better. Do not ask for special circuits or layouts, as these take too much time to prepare. Very simple circuits can generally be sent, but we must be the judge in this matter. If we cannot oblige, your money will be refunded.

Make your postal note payable to "Radio and Hobbies," and address your letters to the "Technical Editor, Radio and Hobbies, 60-70 Elizabeth-street, Sydney, NSW."

E.P. (Torrensville) is puzzled because he has come across three different recommended values of plate-to-plate load for push-pull type 2A3-G valves. He also asks some questions about a Rola input transformer.

A.: The different values of plate-to-plate load are accounted for by different operating conditions. There is no such thing as a standard value of plate load for any given type of valve. If you cannot understand this, we suggest that you read through the article on Output Transformers in the March issue, which dealt in detail with this subject. It will also supply the answer to your question as to how to arrive at a figure of impedance for any given transformer and speaker combination. With regard to the Rola output transformer, we suggest that you get in touch with them in the matter. In these days when materials are scarce, it may be necessary to compromise on design. As far as we know, special transformers are still being made up by the various firms, but delivery is much slower than in normal times. It is better, where possible, to use standard components.

M.J.C. (Hampton, Vic.) has a Duplex Single receiver which does not operate as it should at the low frequency end of the band.

A.: Your trouble is probably that the reaction is not working over that portion of the band. The reaction condenser should have a maximum capacity of at least .0001 mfd. Try the effect of adding a few turns to the reaction winding or of pushing the winding nearer to the grid winding. There is a limit to this, however, as the receiver may become uncontrollable at the high frequency end, if you add too many turns. Reducing the amount of aerial coupling may possibly have the desired effect. You could also try the effect of increasing somewhat the voltage on the plate of the detector.

C.S.T.B. (Concord West) suggests that we publish a circuit for the Dual-Wave Pentagrid with a vibrator unit. He asks some general questions re vibrator operated receivers.

A.: Thanks for the suggestion, but we understand that, at the moment, vibrator units are very scarce. As soon as they become more readily available, we will certainly face up to the matter of vibrator operated receivers. Actually, they have a great deal to recommend them. No B batteries or C battery are required, which is particularly helpful these days. They are economical to run, except where charging facilities are not readily available. The vibrator units are reasonably reliable and will give 12 months service or more, depending on the amount of use which they have.

Provided the receiver is designed properly for vibrator operation, there are no outstanding disadvantages. However, it is quite a big job to convert a standard battery receiver to vibrator operation. The easiest way is to retain the existing A battery and C battery, substituting the vibrator unit and its own accumulator in place of the B batteries.

D.McK. (Strathfield) suggests that we should describe more receivers for shortwave fans. He would be very interested in noise limiter circuit and a regenerative preselector unit.

A.: Yes, we realise that it is about time that we described another receiver for shortwave listeners. The other suggestions are also quite good. However, the great difficulty at present is to find the time necessary to the development of specialised receivers and circuits. However, don't give up hope. We will keep your suggestions in mind. Thanks for the remarks and the good wishes.

A.T.S. (Melbourne) suggests that all is not well with the point-to-point wiring diagram for the amplifiers PA-1 and PA-2 in the February issue.

A.: From your letter it appears that you have failed to notice the resistor panel on page 35 of the same issue. If you haven't already come across it, you should find that this will explain the apparent omissions. We will be glad to hear your report re the performance of the various "Radio and Hobbies" circuits.

G.S. (Mayfield) asks some particular questions in regard to the design of a shortwave receiver.

A.: Your circuit leaves a lot to be desired. The 58 should be used as the r-f amplifier with a 10,000 ohm variable resistor in the cathode circuit to act as an r-f gain control. The screen must be bypassed to earth as well as the cathode. Use the 57 as the detector. It is essential to include reaction, which is not provided for in your circuit.

The switch must be wired so as to switch the aerial, plate, and grid circuits to the various coils in turn. The "earthy" ends of the coils can be connected permanently to the proper places. You will have to take great care to see that all the leads are as short as possible, as otherwise the arrangement will be very inefficient.

In regard to the coil connections, we suggest that you had better write to RCS, being careful to state exactly the types of coils which you have on hand. The dial you mention should be OK, provided that the movement is quite smooth and not jumpy in its action. The question of resistance versus transformer coupling is a very big one. In any case, it is impossible to say that either method is better than the other. Each has its own advantages and disadvantages, which make it more or less suitable for different applications.

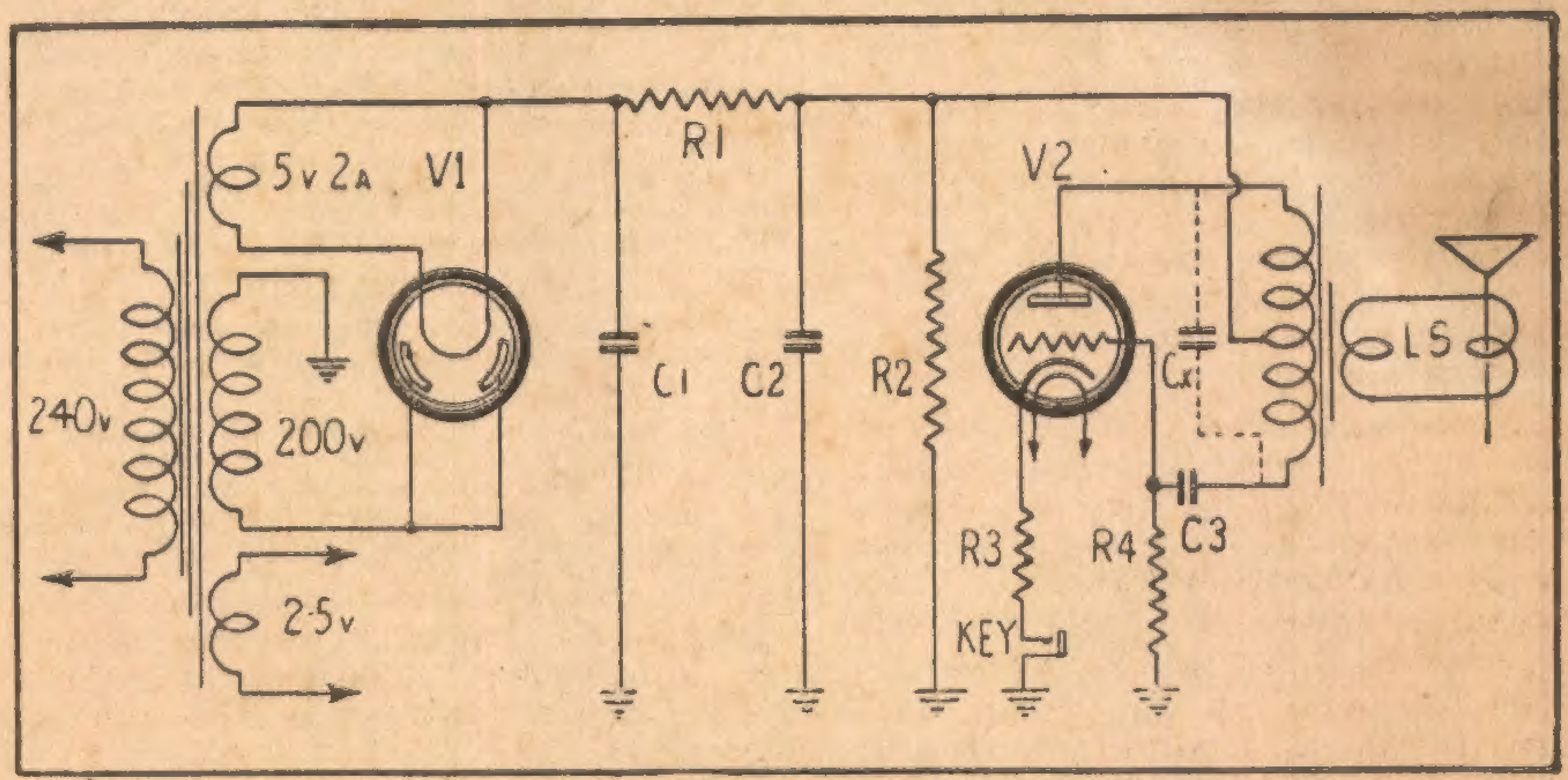
I.B. (Bunbury, WA) sends in a long and interesting account of various experiments with public address amplifiers. Apparently a number of local enthusiasts pooled their gear and tried out a lot of different schemes.

A: We read through your letter with much interest. The idea of pooling the gear is a good one and certainly allowed you to do a lot more than would otherwise have been possible. Space does not allow us to comment on each point in the letter. However, we will be glad to have a chat with you when you are in this part of the continent.

M.G. (Tamworth) wants the circuit of the "ZUG" crystal set, which he thinks was published in "Wireless Weekly" about 1936.

A.: Sorry, but the copies of "Wireless Weekly" of that vintage are not indexed and the only way we would have of locating the circuit would be to search through the whole of our files on the off chance of coming across it. Under the present circumstances, such a thing is quite out of the question. Maybe one of the other readers may be able to help.

THE A-C OPERATED MORSE OSCILLATOR



Unfortunately, there was a rather obvious error in the circuit of the A-C operated Morse Oscillator published last month. The grid resistor R4 was returned to the wrong side of the grid condenser, leaving the grid floating and providing a D-C path from B plus to earth. The corrected diagram is shown above. We suggest that the necessary alteration be made on the original circuit so as to guard against possible difficulty at some later date.

A.G.D. (Marrickville) has a portable receiver which is apparently out of action owing to scarcity of batteries. He asks whether it would be possible to modify the set using a-c valves and a B eliminator for high tension supply.

A: If you could get A batteries, the B eliminator could be used as a high tension supply with the present valves, provided that the voltage was not made higher than that for which the set was originally designed. Alternatively, the receiver could be changed over to use 2.0 volt valves and operated from a 2-volt accumulator and B eliminator. For all-mains operation a-c valves would be the best proposition. However, in this case, the best plan would probably be to build up a new high tension supply unit as an integral part of the receiver. Whatever you do, the job will not be a simple or an inexpensive one.

E.H.J. (Ballarat) makes a number of suggestions in regard to "Radio and Hobbies." (1) That we should include the complete heater circuit in all a-c receivers and amplifiers. (2) That we should give chassis dimensions for all chassis used. (3) That we should publish a special version of the Little General receiver, using a larger power transformer.

Thanks for your interest in "Radio and Hobbies" and for the suggestions. There is no need to be apologetic, as we are always glad to hear the opinions of our readers. The idea of showing the complete heater circuit is good in some respects, but it makes the circuit appear much more complicated and it is, therefore, of doubtful value. However, we agree that the point could well be mentioned in the description. We had already thought of the idea of including chassis dimensions and intend to do so when circumstances permit. The chassis for the amplifier PA-3 is the same as for the PA-1 and PA-2. Essential dimensions were given in the February issue, on page 35. Note that the dimensions are for the underneath view of the chassis. We will keep in mind the third suggestion but cannot make any promises at the moment.

L.G.K. (Newcastle) sent in a circuit for a preamplifier and asks a number of specific questions.

A: Sorry, L.G.K., but we cannot reply by letter unless you make use of the Shilling Query Service. The circuit appears to be in order, although the circuit constants differ from those which we usually recommend. The omission of the gain control potentiometer is quite in order, provided that the input voltage is kept sufficiently low. With a high value of input voltage, you might find that the second stage would overload. There is no need to switch out the bleed resistor when using the preamplifier as the current drain of the latter is very low. When the preamplifier is not in use, it is quite in order to open the heater circuit.

BROADCAST DX

George Rhodes, Canberra.—Thanks so much for your letter; that receiver of yours appears to be a splendid type for DX. Glad you like the section and magazine generally. I shall write you personally, re short-wave stations above 50 metres.

Mr. George Cameron, Mosman, NSW.—That Morse code practice session from 2YC is certainly helpful for those keen on learning the code. Yes, I think you should hear many of the stations listed in "R. and H." at Mosman. Hope you get a few "spare" nights, soon, so you can have a shot at some of them.

Mr. M. B. Schilling, Wingham, NSW.—Glad you like the section, and that the station list may be of use. The Japanese on 590 would have been JOAK, Tokio, but I have not heard it of late either. FJP, Noumea, New Caledonia, used 588kc/s last year for a while. You people on the North Coast seem to be in a good reception area indeed.

Mr. Gordon Obey, Bronte, NSW.—I hope you will be able to contribute notes regularly O.M. KFPL is a good catch, according to my lists, it only uses 250 watts. The Hill-Billy show from KNX, 11.30 pm, Saturdays, sounds enjoyable. Sincerely hope the "Verie Gods" are with you, and that the reports are verified.

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SHORT-WAVE REPORTS

Mr. A. Cushen, Invercargill, NZ.—Thanks very much for your card which you will notice has been referred to in the body of the magazine. It is always interesting to hear of conditions from the far side of the Tasman, they can often be so annoyingly different from what they are over here.

Mr. J. Roberts, Rosebery, NSW.—A letter from a new correspondent is always welcome. You certainly get around on your low-powered receiver, judging by the log you turned in. We have heard the stations you mention but are afraid you have better luck with the South Americans than we have. Will welcome hearing from you at any time.

Mr. H. Cox, Cobden, NZ.—Glad to get your letter and to hear that you received your "R. and H." at last. GSL certainly puts a fine signal out, as for that matter do most of the Daventry transmitters. Thanks for the information as regards KEI. Any NZ magazines would be very welcome here as we have never seen any. Hope that your overdue veries turn up soon. Kind regards.

Dr. K. B. Gaden, Quilpie, Q.—We were pleased to receive your letter, which we have answered by mail. Thanks very much for the interesting details and the good wishes for the future. Will try for HCJB in the early hours. As regards the first "mystery," I had already heard it and had interpreted it as being XGOY. The other one, I have not heard as yet.

Mr. R. Hallett, Enfield, NSW.—Wishing you every success with your new feature. Have communicated with you by mail. Hope that your new aerial has survived the elements and that it will prove more efficient than its predecessor. I feel that you have the best of the lot for all-round reception. Best wishes.

Mr. R. K. Clack, Beresfield, NSW.—Very pleased to read the sentiments expressed in your letter to Mr. Simpson, and which he has asked me to answer for him. I agree that his absence will be a great loss; however, I hope to help make up the deficiency. I wonder at your not hearing KEJ again but you are not working under the best of conditions. Would be interested to hear what receiver you are using now. Sorry to hear of the interference problem; how about an efficient wave-trap?

Mr. I. L. Hill, Nulkaba, NSW.—Another new correspondent whom we are very glad to welcome to our pages. You are getting exceptional reception with your 6C8G working solo. Quite correct about Saigon; it is heard again in the 25m band. Thanks very much for your informative letter.

Mr. M. Foster, Mount Vincent, NSW.—Thanks for your report, which was very interesting. Sorry to read that this may be your last report, owing to war conditions, but you may be sure that we will be glad to hear from you at any time you care to drop us a line. Best of luck.

Mr. H. Perkins, Malanda, Q.—Thanks for your letter and the fine log which you sent in. Pleased to hear that you receive so many stations. The afternoon stations break through here much earlier than up in Bananaland. You were certainly lucky with the veri's kind regards.

Mr. J. Buckley, Goulburn, NSW.—We were very pleased to hear from you and were extremely interested in the details therein. You will realise that I received your letter in good time. Bad luck you were unable to get the call of the station on 18.9m. I have not heard this one as yet but hope to in the near future. Best wishes.

Mr. E. C. Jamieson, Forreston, SA.—We are very grateful to receive your detailed log, which is very comprehensive and was very useful. You must have a very fine location and an equally good receiver. Pleased to notice that the Africans come in so well. Will be glad to hear from you again. Regards.

Mr. E. Dobbs, Stanmore, NSW.—Thanks for letting us know that you have had such success with your "R. and H." receiver. We are also glad that you in company with many others appreciate our efforts and like our book so much. Looking forward to getting a fine log from you soon. Best wishes.

Mr. W. J. Williams (Clovelly): Your letter arrived in time for this acknowledgment to be squeezed in at the last moment, but not in time for a reply to be received from the shortwave editor to reply. Thanks for the enouraging remarks re "Radio and Hobbies."

Mr. Hanson, Merrylands, NSW.—Thanks much for the visit and hope that you rea home in time for lunch. Although I did get your letter, it was sent on to Mr. S son; I think that you must have cov your log in our conversation. Hope that Africans are still coming in at your loca Best wishes.

WANTED TO BUY, SEL OR EXCHANGE

READERS who wish to buy, sell or excha goods are invited to insert an advert nent in these columns of Radio and Hobb The cost of such advertisement is 9d line for a minimum of three lines, making minimum charge 2s 3d. As regards spa it is reasonable to count seven words letter groups per line.

Your remittance in cheque or postal n must accompany your advertising copy. Ra and Hobbies cannot accept responsibility any advertisement, but reserves the right decline any advertisement for any reas Give your full postal address, as we can undertake to forward replies sent direct to

FOR SALF

R. and H.'s, Vol. 1, No. 1, to Vol. 3, No. 36 Copies, Vol. 1 bound. £2 and freig **B. Healey, 58 Denison-rd., Lewisham, N.S.**

FOR SALE.—1 Delta Multitester, new ty D1503. Perfect order. Particulars, ap **Mrs. M. Barton, Boree Creek.**

WANTED

WANTED.—2 (Two) Heavy Duty Garrard Collard Gramophone Motors. 1-T1001 Te funken Pick-up. **J. F. Knox, 13 Point-ro Northwood. JB2471.**

WANTED immediately Wireless Operato and Skilled Wireless Mechanics for fu time duty throughout N.S.W. Standard Arr rates of pay. Aplications to be made in wri ing, or person, to **Staff Officer, Signals, V.D. H.Q., rear Mint Building, Macquarie-stree Sydney.** Persons already serving are ineli ible, except in special cases.

WANTED.—Second-hand Radio Parts, Se Valves, new and used. Good conditio Cheap. Also wanted urgently: Motor Cyc Tyres, Tubes to match, 25" x 3", or a litt larger outside diameter, fit rim 24" x 2¼". Sta prices. **F. J. Willcox, Post Office, Gibsonval via Ungarie, N.S.W.**